Navigation Improvement Study
Reconnaissance Report

Gloucester Harbor
Gloucester, Massachusetts

July 1995

US Army Corps of Engineers
New England Division

NAVIGATION IMPROVEMENT STUDY

GLOUCESTER HARBOR
GLOUCESTER, MASSACHUSETTS

RECONNAISSANCE REPORT

JULY 1995

PREPARED BY:

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

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INTRODUCTION

Gloucester Harbor, shown in Figure 1, is located about 25 miles northeast of Boston, Massachusetts, on the southern shore of Cape Ann in Essex County. The Outer Harbor, protected by the Federal Dog Bar Breakwater, has an area of about 1,000 acres within the -18-foot mean low water (MLW) contour. The Inner Harbor, located off the northeast end of the Outer Harbor is the site of the city's commercial district, fisheries wharfs, shipping terminals, marinas and boat yards.

Gloucester Harbor is the second largest fishing port in New England, second only to New Bedford, having landed a total of 101.7 million pounds of fish in 1992 valued at over $34 million (Waterborne Commerce of the United States). The recent declines in Northwestern Atlantic fisheries stocks have crippled the industry as landings have declined by more than 50 percent since 1980. This has led local seafood processors to a greater reliance on imported frozen fish to satisfy demand for their products. As the volume of frozen seafood shipments into Gloucester has increased, shippers have begun using larger vessels to serve this trade. The growth in vessel size has begun to exceed the capacity of the channel to accommodate these ships at all tidal stages.

The city would like to have the channel deepened to accommodate larger carriers, which it believes, would enable port industries to diversify and provide greater employment opportunities for area residents in the marine trades. The city would like to attract additional containerized cargo operations beyond the frozen fish trade, as well as cruise vessel landings. For these reasons the Massachusetts Deputy Pilot's Commissioner and the City of Gloucester requested the New England Division to examine the feasibility of providing navigational improvements, namely deepening of the existing Federal channel system, at Gloucester Harbor.

STUDY AUTHORITY

This study was conducted under the authority of Section 107 of the River and Harbor Act of 1960, PL 86-645, 33 USC 577, as amended, for the purpose of navigation improvement.

STUDY PURPOSE AND SCOPE

The purpose of this reconnaissance study is to determine whether Federal involvement in further planning and feasibility study efforts, aimed at alleviating navigational inefficiencies for commercial cargo vessels and shipping interests, is economically justified or otherwise in the Federal interest.

Gloucester Harbor is utilized by commercial fishing boats, container ships carrying mainly frozen cargo, dry bulk barge carriers as well as recreational craft. The waterfront encompasses the full spectrum of marine services, public wharf facilities, vessel repair and provisioning facilities and services, marinas, terminals handling petroleum products, containerized cargo, fresh and frozen seafood and a U.S. Coast Guard group. The economic impact expected to accrue to these facilities and shippers with a deeper channel was measured and weighed against the cost of providing an improved channel.

PRIOR STUDIES AND IMPROVEMENTS

Gloucester Harbor has been the subject of numerous Congressional Acts and resolutions and Corps reports since 1870. The first report on the harbor, prepared in response to the River and Harbor Act of 1870, and published in the Annual Report of the Chief of Engineers for 1871 (AR 1871), recommended removal of various ledges and large boulders from the Inner and Outer Harbors and construction of a breakwater extending west from Eastern Point. The removal of the ledges was authorized by the River and Harbor Act of 1872, and was substantially completed by June of 1873. Further ledge removal and breakwater construction were again recommended in reports published in 1884. Additional ledge removal at Babson's Ledge was authorized by the River and Harbor Act of 1886 and was completed in 1888.

A Survey Report published in the Annual Report for 1887, as called for by the River and Harbor Act of 1886, again recommended construction of the breakwater across Dog Bar west of Eastern Point, and also recommended dredging and ledge removal to provide general access to the wharves along the northern waterfront of the Inner Harbor to -15 feet MLW from Babson's Ledge northeasterly to Pews Wharf and the dredging of Harbor Cove to -10 feet MLW. This Inner Harbor dredging work was authorized by the River and Harbor Act of 1888. This work was begun in 1888 and completed in July of 1894.

The River and Harbor Act of 1894 authorized the construction of the Dog Bar Breakwater. Construction was begun in November 1894 and continued under successive contracts, with several minor interruptions and design modifications, through its completion in 1906. The original breakwater was to have extended to Round Rock, however, a modification authorized by the River and Harbor Act of 1902 called for terminating the structure at Cat Ledge. Reproductions of the original maps from many of these prior reports are shown in Appendix E, and may be referenced for the locations of many of the features mentioned in this section which do not appear on other figures in this report.

The River and Harbor Act of 1896 authorized removal of additional ledge pinnacles and rocks including Elishas Rock in the Outer Harbor and rocks in the Inner Harbor near the ferry landing on Rocky Neck. This work was undertaken between July and August of 1897.

The River and Harbor Act of 1910 authorized further ledge removal in both the Inner and Outer Harbors as recommended in reports published in 1907 and 1908. The Inner Harbor ledge removal consisted of work on reducing three ledges which had been found not to have been entirely removed to the intended elevations under prior contracts. The work in the Outer Harbor consisted of the removal of Prairie Ledge to -25 feet MLW and the removal of Tenpound Island Ledge and adjacent ledge areas to -18 feet MLW. This work was begun in May 1912 and completed in December 1916.

SCALE 1: 25000

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FIGURE 1
PROJECT LOCATION

Storm damage to the Dog Bar Breakwater has resulted in many repair operations and a few design modifications since its completion. The River and Harbor Act of 1911 provided appropriations to supplement the design of the structure through placement of an extended apron composed of heavy rubble stone along the seaward face. This work was completed in December of 1912. Repairs to the structure were undertaken in 1908, 1913, 1931, 1933-34, 1935, 1939, 1940, and 1965-66.

A House resolution in 1929 and the River and Harbor Act of 1930 both called for examinations of Gloucester Harbor with a view towards more extensive ledge removal and dredging in Gloucester Harbor and for Federal assumption and improvement of the Annisquam River Waterway as part of the Intracoastal Waterway system. A series of reports prepared between 1929 and 1932 examined extensive proposals to remove the various Outer Harbor ledges and shoals to depths of -35 and -30 feet MLW, deepening of the Inner Harbor to -18 or -20 feet MLW. These reports ultimately concluded that further improvements to Gloucester Harbor itself were not warranted, but that adoption and improvement of the Annisquam River Waterway, with widening of the channel and deepening to -8 feet MLW, was warranted. The River and Harbor Act of 1935 adopted the project for the Annisquam River and the project was constructed between August and November of 1936.

A House resolution in October 1938 resulted in a further examination of additional ledge removal in the Inner Harbor and further improvements to the Annisquam River channel including bend widening and provision of anchorage areas at Annisquam village. The report again found that further improvements to Gloucester Harbor itself were not warranted. The report did recommend that the desired bend widening in the Annisquam River could be accomplished under the existing authority for operation and maintenance and that further study of the Annisquam anchorage proposal was warranted. The bend widening modification was accomplished during maintenance operations undertaken between September and November 1940. A Survey Report published in August of 1940 recommended modifications to the waterway consisting of a 17.3-acre by -8 foot MLW anchorage in Lobster Cove. This modification was authorized by the River and Harbor Act of 1945 and was constructed between September and November of 1958. Further maintenance dredging of the Annisquam River waterway has been undertaken in 1949, 1957, 1965, 1967 (boulder removal), 1970 (bar channel only), 1972 and 1976 (bar channel only).

House resolutions in 1955 resulted in a Survey Report, published in 1961, which recommended extensive improvement of the Inner Harbor. The improvements recommended in that report consist of: providing a main harbor entrance channel -20 feet MLW by 300 feet wide leading to a turning basin of the same depth and 600 feet in diameter in the center of the Inner Harbor, removal of a ledge along the north limit of this channel opposite Fort Point and Harbor Cove to -24 feet MLW, deepening of Harbor Cove and the 500-foot wide area abreast the channel off Fort Point to -18 feet MLW, providing a -20-foot MLW north branch channel along the northwestern waterfront at widths of 200 to 225 feet, providing a -20-foot MLW south branch channel along the southeastern waterfront at 200 feet wide, a -15-foot MLW by 5-acre anchorage east of the entrance to Harbor Cove, a -16-foot MLW channel 300 to 650 feet wide in lower Smith Cove and a -10-foot MLW by 10-acre anchorage between the two branch channels east of the turning area. These improvements were authorized by the River and Harbor Act of 1962. Construction began in October 1964 and was completed in July 1965.

The existing Federal navigation project for Gloucester Harbor and the Annisquam River, as shown in Figure 2 (Gloucester Harbor only), consists of the following features:

Gloucester Harbor

1) A breakwater extending westerly from Eastern Point, about 2,250 LF to Cat Ledge, rubblestone up to an elevation of MLW with a top width of 31 feet and slopes of 1:1.3 leeward and seaward slopes of 1:1.5 up to elevation -12 feet MLW then 1:3 up to MLW, surmounted by a fitted stone superstructure composed of 2 walls filled in between with rubble stone and capped by heavy dimension stone with a top elevation of +17 feet MLW and top width of 10 feet, with a heavy rubble-stone apron along the toe of the superstructure's seaward face, the head of the structure being widened and increased in elevation to +20 feet MLW to support a lighted navigation aid. Adopted 1894 with design as modified 1897, 1902, 1904 and 1911.

2) Removal of Ledges in the Outer Harbor, Prairie Ledge to -25 feet MLW, and Mayflower Ledge, Tenpound Island Ledge and Ledges "F" and "I" to -18 feet MLW. Authorized in 1910 and completed in 1916.

3) Provision of the main channel, branch channels and turning areas at -20 feet MLW, the Fort Point-Harbor Cove access and anchorage area at -18 feet MLW, the -15-foot MLW Harbor Cove anchorage, and the two -16-foot MLW anchorage areas in the Inner Harbor and lower Smith Cove, as detailed above from the 1961 recommendation, superseding previous projects for the Inner Harbor. Authorized in 1962 and completed in 1965.

Annisquam River

1) A channel -8 feet MLW by 60 feet wide leading north from Gloucester Harbor through the Blynman Canal to the railroad bridge, then 100 feet wide to Annisquam, widened further through the bends, then 200 feet wide across the bar at the river's mouth at Ipswich Bay, with an anchorage 17.3 acres by -8 feet MLW in Lobster Cove, with removal of ledge M at the Gloucester Harbor entrance to -8 feet MLW. Authorized in 1935, modified in 1940 (O&M) and 1945 and completed in 1958.

In 1981, the city of Gloucester requested an examination of potential improvement to Smith Cove to accommodate the city's scattered fleet of small inshore lobster boats. A series of reports prepared under the authority of Section 107, culminating in a Detailed Project Report published in February 1990, recommended a -8-foot MLW channel extending southwesterly from the existing 16-foot channel in lower Smith Cove up to the head of the cove where a 3-acre anchorage at the same depth would be dredged off the proposed public landing area. During the preparation of Plans and Specifications for this project, however, the anticipated disposal methodology for the dredged material was changed as a result of changes in the testing protocols and criteria for acceptance of dredged material for ocean disposal. As the state and local sponsors were unable to come up with an alternate means of disposal, further efforts on the improvement project were terminated in May 1995.

CORPS OF ENGINEERS

U. S. ARMY

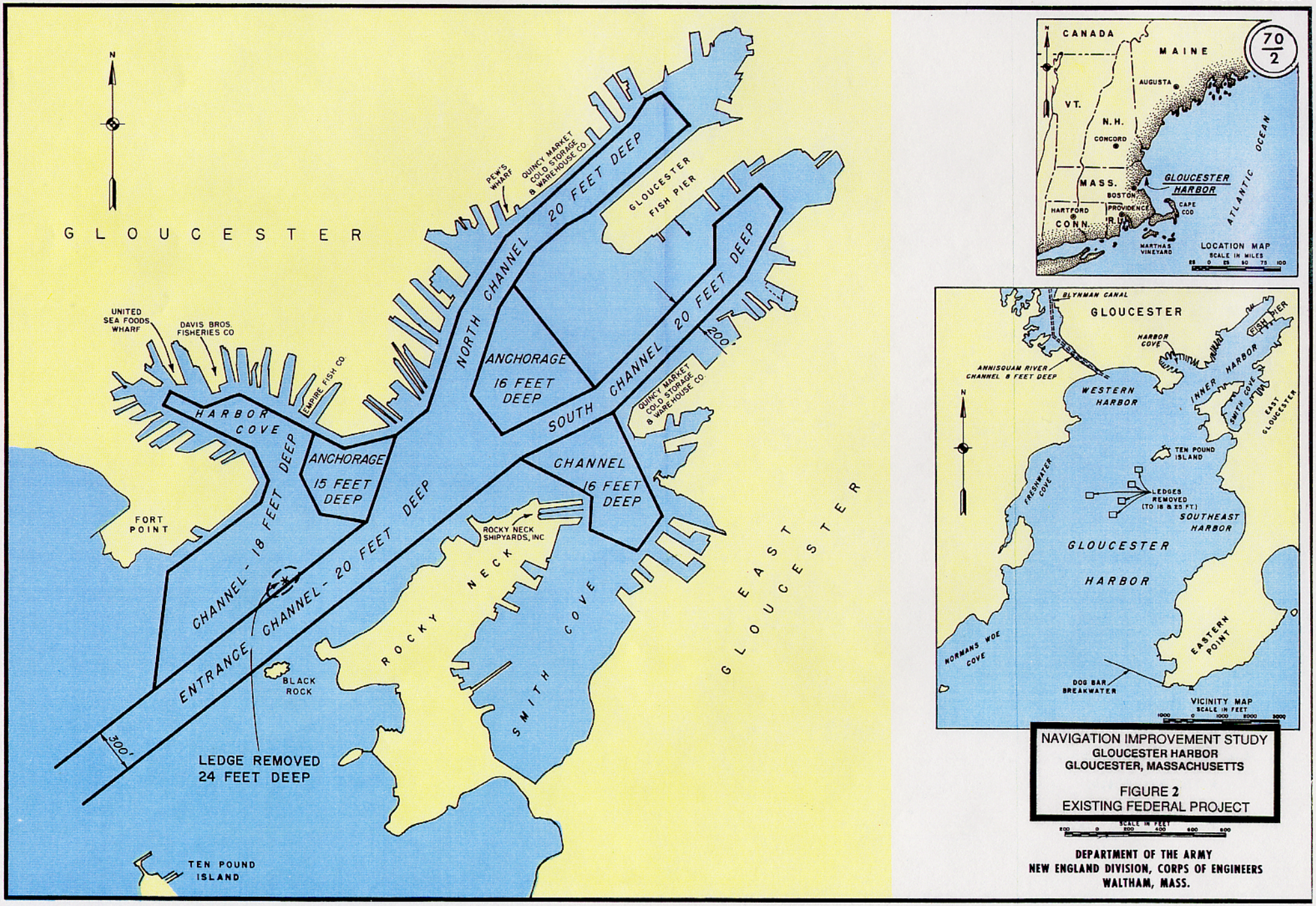

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FIGURE 2
EXISTING FEDERAL PROJECT

SCALE IN FEET

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

EXISTING CONDITIONS

This portion of the report describes the existing conditions in the study area including the natural setting, harbor use and development and other information collected from past reports, current maps and surveys and information provided by local officials and harbor interests.

NATURAL SETTING

Gloucester Harbor is a large natural embayment between the headland of Cape Ann and the mainland to the west. While the Inner Harbor is relatively protected, the Outer Harbor is exposed to winds and waves out of the southwest and before construction of the Dog Bar Breakwater, seas from the south were also a problem.

Gloucester Harbor experiences mean and spring tidal ranges of 8.8 and 10.1 feet respectively. The harbor can be found on the USGS 7-½ minute Topographic Maps titled "Gloucester, Massachusetts" and "Rockport, Massachusetts," and on the NOAA Coast Charts #13281 "Gloucester Harbor and Annisquam River" and #13279 "Ipswich Bay to Gloucester Harbor."

HARBOR FACILITIES AND PRESENT NAVIGATION

Land use around the Inner Harbor at Gloucester ranges from public open space and residential use to industrial use. Residential use is concentrated on Rocky Neck which separates Smith Cove from the Inner Harbor proper. Most of the industrial/commercial use is related to the many terminal facilities, the majority of which are involved in seafood transport and processing. The harbor contains 12 marina facilities, 7 boat yards and repair facilities, 4 general cargo wharves including the state fish pier, 3 vessel provisioning facilities, 3 lobster wharves and 17 fish processing plants, and supports a commercial fishing and shellfishing fleet of about 150 craft. Many of the waterfront's residential and retail properties also have dockage and rental slip space for small recreational craft. Of the Inner Harbor's 60 active waterfront facilities, about 60 percent are used directly by the commercial fishing industry.

The current 20-foot channel depth accessing most of these facilities is sufficient for the recreational, charter and fishing fleets working out of Gloucester Harbor. The only operations restricted by the current channel dimensions are those dependent on access for the large cargo/container ships involved in the international trade of frozen food products. As fish landings have declined at Gloucester, the harbor's many cold storage facilities have been left with excess capacity to accommodate the increase in imports. Landings are made directly at waterside storage facilities with berths of sufficient depth to accommodate these vessels, or at Rowes Square Wharf where cargo is transhipped to other area storage facilities or processing plants. There are four facilities currently receiving such shipments by large carriers. Americold Corporation operates two cold storage and processing facilities, one located on the south branch channel known as the East Main Street Wharf, the other located on the Rogers Street Wharf along the north branch channel. The wharf area at Rowes Square is located further upstream along the north branch channel and supports three facilities, a third Americold wharf used for container cargo offloading, the Gorton's Seafood processing facility, and a wharf area recently purchased by Elliot Shipping from Gorton's to use for general container cargo offloading. The state also has plans to rebuild and upgrade the north branch channel bulkhead of the State Fish Pier to enable it to handle general cargo. The locations of these facilities is shown in Figure 3.

PROBLEM IDENTIFICATION

This portion of the report discusses the nature and scope of the problems with navigation being focussed on in this study. From an analysis of these conditions and problems, planning objectives and constraints were identified to direct the formulation of alternative potential solutions.

The principal problem at Gloucester Harbor, as identified by local officials and shipping interests, is a lack of adequate channel depth in the entrance and interior channels and insufficient maneuvering area. These inadequacies in project dimensions result in inefficient operating conditions for the larger commercial carriers, carrying mainly bulk and containerized frozen foods, which in recent years have come to represent a higher proportion of the port's commerce.

WITHOUT PROJECT CONDITION (NO FEDERAL ACTION)

Without Federal action concerning this particular issue of channel dimension adequacy, the problems with harbor access for larger vessels would continue as at present. The largest of the vessels which currently call at Gloucester would have to time their arrival at the port to coincide with higher tidal stages, or wait to enter the harbor if they arrived at an unfavorable tide level. Departures for vessels would be similarly affected, with vessels waiting for higher tide levels to leave their berths and transit the channel. The occasional vessel which would need to lighten its load in Boston before calling on Gloucester would continue to do so. The larger Russian ships which call to take on fish would continue to anchor outside the harbor and would not seek to enter the harbor to berth.

Under the Corps' engineering design criteria for navigable waterways, channels and other navigation features are designed with an allowance for safe underkeel clearance. For the types of vessels using Gloucester Harbor, such "safe clearance" is considered to be about three feet. At the existing -20-foot MLW depth, vessels operating at drafts of greater than 17 feet would be subject to some theoretical delay potential, particularly on minus tides. The actual practice of harbor pilots and vessel operators generally differs from that contemplated by design parameters. Gloucester pilots have stated that vessels drawing greater than 18 feet are subject to some delay at around low water, and the frequency of delay quoted by the pilots conforms more closely with the frequency of arrivals for vessels drawing 19 feet or greater. The following paragraphs and table discuss and display the anticipated without project condition at Gloucester Harbor in light of the difference between project design parameters and actual operating practices.

The Eastern Point Pilots, who handle pilotage for Gloucester Harbor, supplied data for their activities from 1990 through the middle of 1994. The breakdown of the number of ships requiring piloting at Gloucester is shown below. Analysis of the operational conditions at Gloucester was based on this data. Table 1 provides a comparative breakdown of vessels calling at Gloucester for three vessel drafts, 17, 18 and 19 feet, over the 4-½ years for which data was provided. These figures exclude those for the few deeper-draft vessels going only to the anchorage. Table 1 also shows the average drafts for the all piloted vessels and for those segments of the fleet with drafts greater than the three cut-off levels. During this 4-½ year period the average draft of piloted vessels at Gloucester has also increased by more than 2-½ feet (from 16.2 feet to 18.8 feet). In comparison with the 3-foot underkeel clearance design

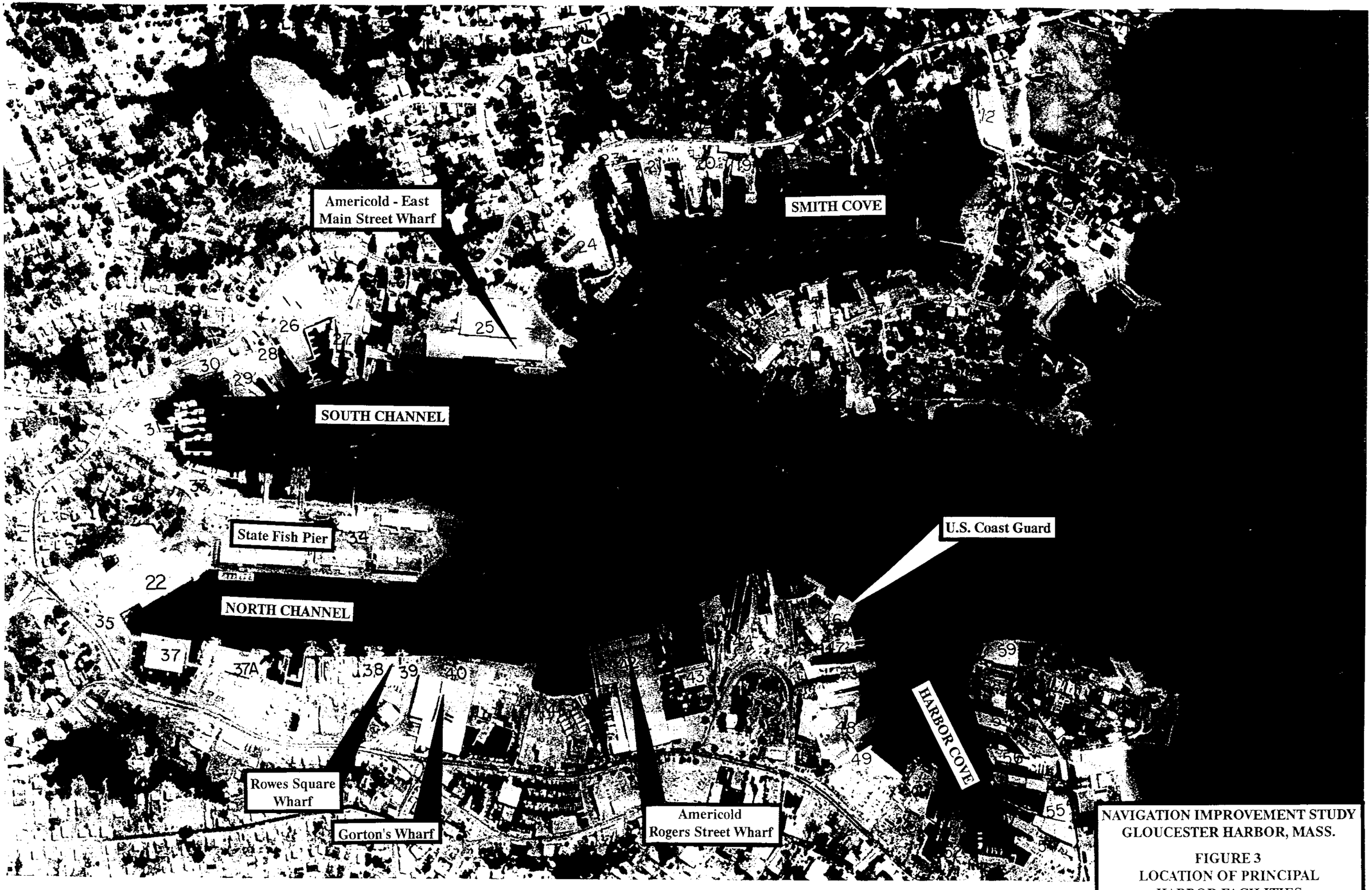

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FIGURE 3
LOCATION OF PRINCIPAL
HARBOR FACILITIES

requirement, this means that the Gloucester arrivals have increased in average size from a point less than one foot inside the draft that could theoretically experience no delays in the 20-foot channel (17 feet) to an average size (18.8 feet) that is more than 1.5 feet greater than the draft subject to potential for delay.

The number of vessels which entered the harbor with drafts subject to increased between 1990 and 1993, the last year for which complete data has been transcribed. This is apparent at both the theoretical 17-foot draft and the 19-foot actual practice draft. Also, the percentage of those vessel requiring pilot service during the same years, which have drafts subject to delay, also increased between 1990 and 1993 (from 48 to 71% at the 17-foot draft and from 15 to 44% at the 19-foot draft). The pilots, city officials and other harbor shipping interests believe that if this trend towards an increase in the amount of cargo handled by deeper draft vessels continues, then the amount of time lost to tidal delays will thus increase also. However, none of the shippers contacted during the study envisioned increasing the size of vessels calling at Gloucester with a deepened channel.

TABLE 1
GLOUCESTER HARBOR, MASSACHUSETTS
FLEET CHARACTERISTICS AND TRENDS

	1990	1991	1992	1993	1st Half 1994
	Breakdown of Data at 17-Foot Draft				
Draft >17 Feet	16 (48%)	13 (43%)	28 (74%)	29 (71%)	17
Draft <17 Feet	17 (52%)	17 (57%)	10 (26%)	12 (29%)	4
All Piloted Craft	33	30	38	41	21
	Breakdown of Data at 18-Foot Draft				
Draft >18 Feet	9 (27%)	12 (40%)	14 (37%)	22 (54%)	16
Draft <18 Feet	24 (73%)	18 (60%)	24 (63%)	19 (46%)	5
All Piloted Craft	33	30	38	41	21
	Breakdown of Data at 19-Foot Draft				
Draft >19 Feet	5 (15%)	10 (33%)	11 (29%)	18 (44%)	12
Draft <19 Feet	28 (85%)	20 (67%)	27 (71%)	23 (56%)	9
All Piloted Craft	33	30	38	41	21
# of Vessel Piloted to Anchorage Only	None	2	2	3	2
	Average Draft of Piloted Craft by Draft Class				
Average Draft All Craft	16.2'	17.4'	18.2'	18.5'	18.8'
Average Draft >17 Ft	18.3'	21.1'	19.4'	19.9'	19.2'
Average Draft >18 Ft	19.1'	21.5'	21.5'	20.8'	19.3'
Average Draft >19 Ft	20.1'	22.1'	22.4'	21.3'	19.5'

Without any increase in channel dimensions, any trend toward a further increase in the size of vessels in the frozen foods trade would result in increased tidal inefficiencies over time at Gloucester. With a continuing increase in vessel draft, at some future point, the costs of increasing delays and need for lightering at Gloucester would exceed the costs of using alternate ports, resulting in a diversion of cargo away from Gloucester. Local officials and harbor interests are understandably concerned with any potential for a reduction in their port's competitive standing. However, the shippers contacted during this study did not relate any plans to continue increasing the size of vessels engaged in this trade and calling at Gloucester, with or without a deepened channel.

Harbor pilots and operators of seafood processing facilities also related a potential for Gloucester to expand the number of shippers choosing to schedule vessel calls at Gloucester should the channel be deepened. Of specific interest was the landing at Gloucester of frozen seafood loaded in the North Pacific, from fishing vessels working out of eastern Russian, Alaskan and western Canadian ports, which then call on eastern Canadian and European ports. However, the shippers contacted noted that other legal and institutional constraints on their operations preclude any calls at Gloucester for seafood in the North Pacific trade, even if the channel at Gloucester was to be deepened. Federal statute (Nicholson Act) currently prohibits the landing of fish or fish products at U.S. ports from foreign flag vessels when the cargo in question was taken on board or processed (aboard that or any other vessel) on the high seas. 46 USCS Appx §251(a) (1987). This restriction also applies to fish and fish products taken aboard at sea, offloaded at a foreign port for processing and then reladen aboard the same vessel for shipment as processed fish. Vessels involved in this north pacific trade would thus not be able to call on Gloucester in any event.

PLANNING OBJECTIVES & CONSTRAINTS

A planning objective was identified which addresses the problems and needs in light of the without project condition as discussed above. The objective listed below would reduce tidal delay inefficiencies for larger carriers.

- Reduce costs associated with harbor access for deeper draft commercial navigation at Gloucester Harbor during the 1999-2049 period of analysis.

The limited scope of this reconnaissance study did not result in the identification of any specific constraints to the formulation process or the improvement of general navigation facilities at Gloucester Harbor. However, recent experience with the deferred project for the improvement of Smith Cove under Section 107 authority indicates that the potential for elevated levels of contaminants in Gloucester Harbor sediments would be a significant concern requiring analysis should the proposal to improve the main shipping channels be pursued. For the purposes of preparing the cost estimates for this analysis, it was assumed that the material to be dredged from the main channels would ultimately be found acceptable for open water disposal at the Mass. Bay Disposal Site.

PLAN FORMULATION

Systematic consideration of the problems, needs and opportunities in the study area relative to navigational access for larger vessels led to the formulation of an alternative plan for reconnaissance level evaluation. This plan was designed to achieve the planning objective stated previously.

PLAN FORMULATION RATIONALE

The various regulations, circulars and manuals used to direct the implementation of Federal water resources improvement programs establish a standard set of criteria to guide the formulation, design and evaluation of alternative solutions to the problem identified in any study. These criteria permit the development and selection of the plan of improvement which best responds to the planning objectives. In this case, the problem for which assistance was requested and the range of potential solutions are limited. The problem of tidal delays for larger vessels can only be addressed by continuing the existing condition (accepting the problem as permanent), redirecting shipments to alternative ports, or modifying the project dimensions at Gloucester Harbor. Use of alternative ports would occur in response to escalation of the current operational inefficiencies or other economic factors and would not require Federal involvement in its implementation.

Modification of the project dimensions would involve a re-design of the entrance and access channels and turning areas to accommodate the larger classes of vessels currently in use or any that may be projected to be used in the future with the improved project. However, as stated above, the shippers contacted during this study did not indicate any plans to increase the size of the larger vessels now calling on Gloucester. Design considerations were therefore limited to those vessels now using the port. Currently, vessels with drafts up to about 24 feet can access the harbor at high water with a minimum of 3 feet of clearance underkeel during the entire transit to the berth. The deeper berths have depths of -24 feet MLW. Those vessels of greater draft, typically the Russian factory ships taking on seafood, must anchor in the outer harbor to transfer cargo.

FORMULATION OF ALTERNATIVES

The average draft of all vessels entering the port with drafts of greater than 17 feet (those craft subject to potential delay) is about 20.7 feet. Allowing for a 3-foot underkeel clearance, these craft would require a channel depth of -24 feet MLW to eliminate most tidal inefficiencies. The largest craft in this class, with drafts of about 23 feet, would still experience some delays with this channel depth, particularly on minus tides. A channel depth of -26 feet MLW would eliminate all tidal delays for all of these craft except under the most extreme conditions.

The largest class of vessels calling on Gloucester, those now forced to anchor outside the harbor, have an average draft of about 26.5 feet, averaged for all calls for these vessels since 1991. These vessels generally arrive lighter and take on one to two feet of draft as they load cargo. A channel depth of 24 feet (+8 feet for high water and minus 4 feet for transit and offloading time = 28 feet) would allow these vessel to enter and leave the port at half-tide or above, assuming the berthing areas were also deepened. A 26-foot channel depth would only restrict these vessel during the lower quarter of the tidal cycle.

With one exception, all of the terminal facilities used by the deeper draft carriers at Gloucester are located along the North Branch Channel of the Inner Harbor. The one exception, Americold's East Main Street facility is located along the lower end of the South Branch Channel. There being only this single potential beneficiary/user on the South Branch Channel, further consideration of Federal involvement in improvements to that project segment were dropped. Design efforts concentrated on serving the multiple terminals along the North Branch Channel.

The design vessel chosen for analysis, as described previously, was the average of that class of ships calling at Gloucester and presently subject to some degree of delay potential. These craft have an average draft of about 21 feet, a length of 490 feet and beam of 60 feet. The current 300-foot width of the main entrance channel into the Inner Harbor is sufficient to accommodate the beam of these craft in a one-way traffic situation. Provision for two-way traffic of large craft is not expected to be necessary given current traffic volumes. This channel would, however, need to be extended seaward to compensate for any increases in project depth.

The axis of the current entrance channel between the Outer and Inner Harbors does not coincide with the axis of the buoyed approach from the entrance off the breakwater and through the Outer Harbor, which follows the deepest water and avoids the many areas of ledge. The two alignments differ by about 26 degrees, which would require incorporating a 26° bend into the channel design for the seaward extension. The Apex Method was used to determine the bend configuration. As waters in the area of the bend exceed the depths being considered, no additional cost would result from the channel bend design feature. The alignment of the seaward channel extension crosses the alignment of a sewage outfall which extends across the Outer Harbor and out to deep water beyond the breakwater. As the outfall pipe is entrenched into the harbor bottom and the intersection of the channel and outfall occurs in an area with water depths greater than the proposed improvement depth, no impact on channel design or cost is expected.

The North Branch Channel would also need to be widened to accommodate the larger commercial ships now calling on the port. These vessels presently use the branch channel, though with some degree of difficulty. The present channel is 225 feet wide at its lower third, narrows to 200 feet through its middle third, and widens to 250 feet at its upper end. While widening of the upper end is not practical due to the proximity of the various wharves and berths, the lower and middle reaches could be widened to accommodate present shipping. The middle reach would be widened to 250 feet to correspond with the upper reach of the channel, while the lower third which sees the most deeper draft traffic would be widened to 300 feet. Much of these widths would also be incorporated into the expanded turning area in the Inner Harbor as discussed below.

The present turning area, located where the entrance channel widens out between the Coast Guard Wharf on the northern shore and Rocky Neck on the southern shore, is inadequate for the larger vessels currently calling on Gloucester. Expansion of this area is impractical due to the constraints of the abutting rocky shorelines. A short distance further into the harbor, the area of open water widens out at the junction of the two branch channels. By using the area of the head of the entrance channel, the lower end of the two branch channels and a portion the existing 16-foot anchorage located between the two branch channels, a turning basin of adequate diameter was laid out. The basin would allow for a turning diameter of 750 feet or about 150 percent of the design vessel length.

EVALUATION OF ALTERNATIVES

Evaluation of alternatives includes analysis of the level of improved tidal access provided by the two project depths being considered (-24 and -26 feet MLW), the cost of implementation and future maintenance, and the economic benefit attributable to the evaluated improvements.

ALTERNATIVE PLANS

The two alternatives being evaluated, as shown in Figure 4, differ only with respect to design depth. As shown in the figure, the two depth alternatives would have essentially the same dredging footprint. Ten areas within the proposed project limits were identified as requiring ledge removal. Ledge areas would have a project design depth of one foot greater than areas of ordinary material. The allowable overdepth for dredging is two feet in both rock and ordinary material. The 24-foot dredge alternative would therefore have an allowable overdepth of -26 feet, a ledge removal depth of -25 feet and an allowable ledge overdepth of -27 feet MLW. Similarly the -26 foot MLW dredge alternative would have an allowable overdepth of -28 feet, a ledge removal depth of -27 feet and an allowable ledge overdepth of -29 feet MLW. Drilling and blasting of ledge areas would be done concurrently with the dredging of ordinary materials from other areas of the project, shortening the construction time to about four months for the 24-foot depth or six months for the 26-foot depth, including time for mobilization and demobilization of equipment. The volumes of material required to be removed are shown below in Table 2.

TABLE 2
DREDGING AND LEDGE REMOVAL VOLUME ESTIMATES

	Volume (cy) to Project Depth	Over-Depth Volume (cy)	Total Volume (cy)
24-Foot Plan			
Ordinary Material	162,300	129,700	292,000
Ledge Rock	5,300	3,700	9,000
Total	167,600	133,400	301,000
Minus Maintenance			-70,000
Total (Say)			231,000
26-Foot Plan			
Ordinary Material	292,000	168,200	460,200
Ledge Rock	9,000	5,400	14,400
Total	301,000	173,600	474,600
Minus Maintenance			-70,000
Total (Say)			405,000

PROJECT COSTS

The existing Federal project has shoaled to a minor extent since its initial dredging was completed in 1965. A total of about 70,000 cubic yards of ordinary material needs to be removed from selected areas to re-establish the authorized project dimensions. This volume has not been included in the cost estimates. It has been assumed that no new aids to navigation would be required. The costs for the two project depth alternatives are shown below in Table 3.

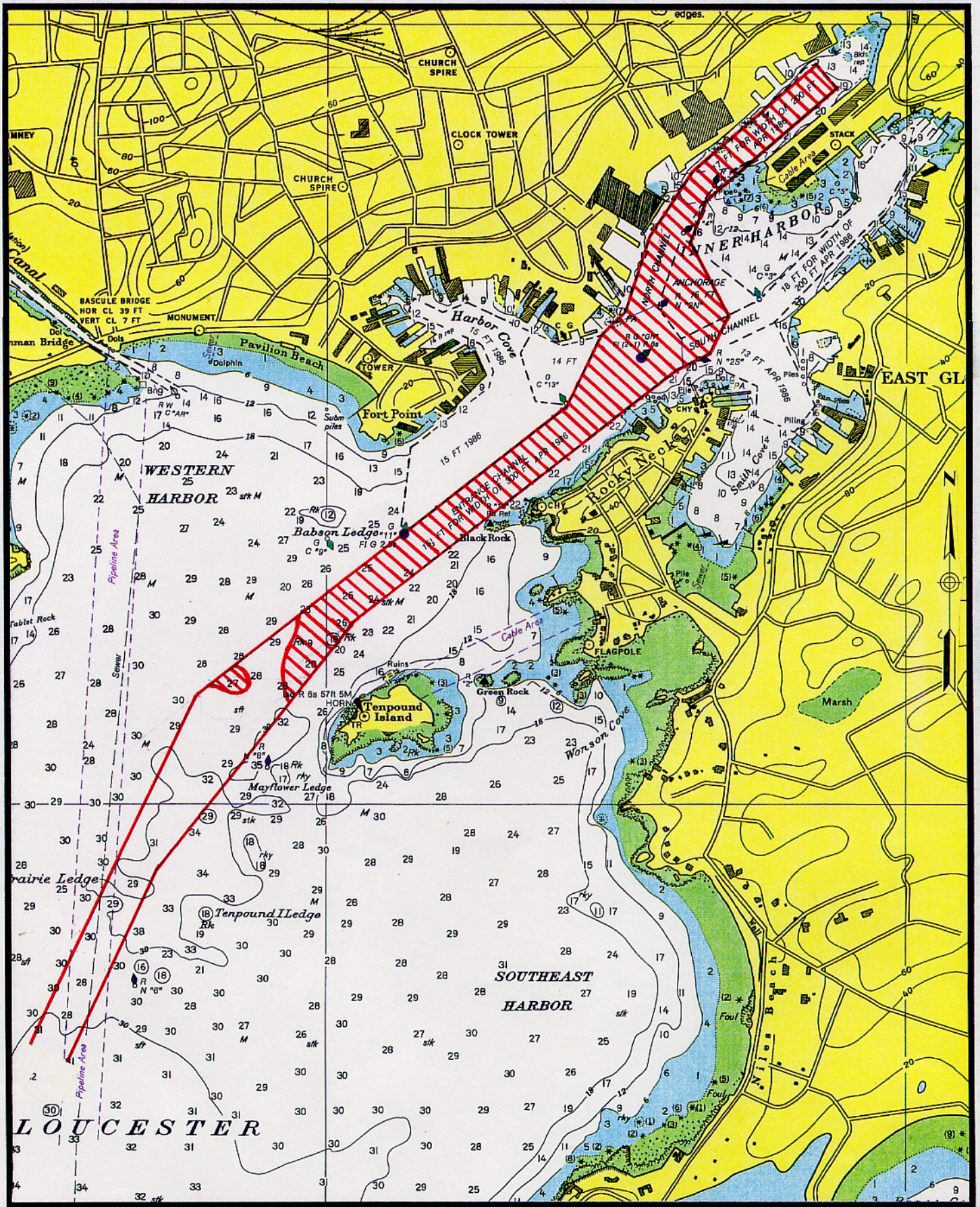
TABLE 3
GLOUCESTER HARBOR, MASSACHUSETTS
COST ESTIMATES FOR ALTERNATIVE DEPTHS

	24-Foot Project	26-Foot Project
FIRST COSTS		
Mobilization/Demobilization	$ 285,000	$ 285,000
Dredging		
Drilling and Blasting of Rock	900,000	1,238,000
Removal of Ordinary Material and Rock	1,467,000	2,572,000
Subtotal	$ 2,652,000	$ 4,095,000
Contingencies	$ 398,000	$ 614,000
Subtotal	$ 3,050,000	$ 4,709,000
Pre-Construction Engineering & Design	75,000	131,000
Construction Management	190,000	324,000
Total	$ 3,315,000	$ 5,164,000
Interest During Construction (7-¾%)	32,000	84,000
Total Investment	$ 3,347,000	$ 5,248,000

ANNUAL COSTS

Table 4 presents the estimated annual costs for the improvement. The existing project will require about 70,000 cy removed for maintenance purposes in conjunction with any improvement activity. This would be the first maintenance operation since the initial construction of the Inner Harbor channels in 1965. Over the intervening 30 year period, this represents a shoaling rate of about 2,300 cy per year within the existing project limits, which cover an area of about 95.4 acres. Of this area, the 19.8 acres which comprise the existing 2,900 foot-long entrance channel are well in excess of the existing project depth and 2-foot overdepth (-22-foot MLW elevation). The shoaling has therefore occurred in an area of 75.6 acres, for a shoaling rate of about 31cy/acre/year.

There would essentially be no expansion of project limits, other than depth, within the Inner Harbor, as the minor modifications to channel width in the North Branch Channel total an increase of only 0.7 acres in project area. The only significant expansion of project limits would involve the seaward channel extension to deeper water. Approximately the upper 2,200 foot reach of the entrance channel currently has depths of between -21 and -26 feet MLW and would thus be subject to dredging and presumably future maintenance under the 24-foot dredge plan. This section has an area of about 15.2 acres, which together with the 0.7 acre increase from the North Branch Channel widening would add about 490 cy annually to the maintenance burden at the current shoaling rate (15.9 X 31). The overall cost per cubic yard for dredging under the 24-foot plan, discounting costs for drilling and blasting and proportional shares of contingencies, CM and PED costs, would be $9.50/cy. This would yield an increased maintenance cost of about $4,700 annually for the 24-foot plan.



Alternative Depths

-24 Foot MLW Main Channel Deepening

-26 Foot MLW Main Channel Deepening

Scale: 1 Inch = @ 1,000 Feet

From NOAA Chart #13281

NAVIGATION IMPROVEMENT STUDY

GLOUCESTER HARBOR
GLOUCESTER, MASSACHUSETTS

FIGURE 4
EVALUATED IMPROVEMENT

Seaward of the -26-foot contour to the -28-foot contour, following both the existing and proposed entrance channel alignment is a further 950-foot reach of channel, widened through the upper portion of the bend, which covers an area of about 7.9 acres. Under the -26-foot dredge plan this area would also be subject to shoaling requiring maintenance dredging. This area, added to the 15.9-acre increase in area under the 24-foot plan would add about 740 cy annually to the maintenance burden at the current shoaling rate (23.8 X 31). The overall cost per cubic yard for dredging under the 26-foot plan, discounting costs for drilling and blasting and proportional shares of contingencies, CM and PED costs, would be $8.90/cy. This would yield an increased maintenance cost of about $6,600 annually for the 26-foot plan.

Project first and annual costs and project benefits were calculated using the currently specified interest rate of 7-¾ percent, over a 50-year project life.

TABLE 4
GLOUCESTER HARBOR, MASSACHUSETTS
ANNUAL COSTS FOR ALTERNATIVE DEPTHS

	24-Foot Project	26-Foot Project
ANNUAL COSTS		
Interest and Amortization (7-¾% - 50 years)	$ 265,700	$ 416,700
Increased Maintenance Dredging	4,700	6,600
Total Annual Cost	$ 270,400	$ 423,300

ECONOMIC ANALYSIS AND JUSTIFICATION

In order for a civil works improvement project to qualify for Federal participation, the project must be shown to be economically justified. The determination of economic justification is made first by undertaking an evaluation of the anticipated benefits to be gained by users of the waterway as a result of the improvements being considered, and second by comparing the anticipated benefits to the estimated costs of implementing and maintaining the project.

The quantifiable benefits of providing improved harbor access at Gloucester Harbor include principally transportation cost savings for cargo carried in larger carriers which are currently subject to some degree of delay or other inefficiencies resulting from lack of adequate channel depth. Only primary economic benefits, those savings directly accrued by vessel and cargo owners in this case, can be considered under Corps of Engineers guidelines. Such primary benefits are those viewed from a national perspective as increasing the overall national output of goods and services, and not merely the gains of one port or region at the expense of another. These benefits are termed National Economic Development (NED) benefits. Secondary benefits to the region or the community at large, such as increased employment in shoreside industries and further economic "multiplier effects" through the local economy, may not be considered in the analysis.

The ability of the large Russian factory processing ships to enter the Inner Harbor was not considered critical. These craft mainly buy directly from the fishing fleet, taking several days to load a sufficient quantity of fresh fish. Provision of the additional two feet of project

depth (to -26 feet MLW) to improve access for these vessels was not considered a priority. The 24-foot channel depth would adequately accommodate the needs of the vast majority of vessels calling at Gloucester and so the ability of this lesser improvement depth to generate project benefits was measured.

Economic Evaluation

Local interests identified three principal areas in which they believe that improved harbor access would increase navigational efficiency and economic activity at Gloucester Harbor. These include the elimination or reduction in tidal delays, eliminating the need to divert or re-route ships so as to lighter the vessel at another port before calling at Gloucester, and the potential of the port to attract additional business, including port calls by cruise ships.

None of the shippers presently doing business through Gloucester were able to provide specific plans as to the use of any deeper-draft vessels. While several shippers expressed a potential for such use by larger ships, none had plans or desires of sufficient confidence and detail (including any proposed vessel dimensions and capacity) to enable them to be weighed in this study. None of the shippers reported that they would significantly change their operations if Gloucester were deepened, but did report that existing operations would be made more convenient and flexible.

The only areas in which the four principal shippers using Gloucester confirmed potential transportation cost savings were in the elimination of tidal delays and the occasional need for re-routing and lightering vessels at other ports. Tidal delays occur when a vessel must wait for the rising tide when seeking to enter or leave the port, or when a vessel adjusts its speed to time its arrival at Gloucester to coincide with a higher tidal stage which will permit entry. Tidal delays cause increased operating costs for shippers which would not be incurred with a deeper channel. Based on records provided covering the past four years, it was estimated that on average 22 vessel delays occur per year and that these delays average about 6 hours each, whether inbound or outbound. Since ships arriving at the port are loaded deeper than those seeking to leave, it was assumed that most delays (about 70 percent, or 15 incidents) would be inbound, while the remaining 30 percent (7 incidents) would be outbound, with hourly operating costs being greater for a vessel at sea waiting to enter port ($515) than for a vessel at the berth waiting to leave port ($430). The total benefit from reducing tidal delays using this method is therefore $64,400.

Local interests provided a second method for estimating tidal delay reduction savings. Local interests estimated that the average tidal delay costs shippers about $7,000 per incident, as an average over both the type and duration of the delays. At 22 incidents per year this equals a total of $154,000 in annual tidal delay reduction savings. The two results from using the two different methods, $64,400 or $154,000, were considered as being the likely upper and lower bounds for the range of tidal delay savings benefits which would accrue from channel deepening at Gloucester Harbor, and have a mean value of $109,200.

Occasionally, excess vessel draft and unfavorable tides combine to prevent vessel access to Gloucester, even with a tidal delay. This typically results in re-routing a vessel to another deeper port, usually Boston, to offload cargo and lighten the vessel. The vessel then back-tracks to Gloucester to offload cargo destined there before continuing on its normal route. Such incidents have occured on average only about twice each year and result in increased transportation time and expense which would be avoided if the channel at Gloucester were deepened.

Local interests estimated that such re-routing incidents add about 9 hours of vessel transit time. Applying this excess transportation time to at-sea hourly operating costs for such vessels ($515) yields an annual benefit of about $9,300.

The evaluated project benefit has a mean value as well as both an upper and lower bound due to the two alternative methods for calculating tidal delay reduction savings. The annual benefits of providing a 24-foot MLW channel depth is shown in Table 5 and are discussed in greater detail in the economic analysis in Appendix C.

TABLE 5
GLOUCESTER HARBOR, MASSACHUSETTS
ANNUAL BENEFITS FOR 24-FOOT DEPTH

	Lower Bound	Mean Value	Upper Bound
Benefit Category			
Tidal Delay Costs Prevented	$ 64,400	$ 109,200	$ 154,000
Re-Routing Costs Prevented	$ 9,300	$ 9,300	$ 9,300
Total Annual Benefit	$ 73,700	$ 118,500	$ 163,300

Project Justification - Benefit/Cost Analysis

A comparison of the annual costs of the evaluated improvements with the annual benefits anticipated to result from those improvements is made to determine project justification. In this instance, the annual cost and annual benefits were compared only for the 24-foot deepening plan as this depth was considered sufficient to eliminate delays for most all vessels calling on the port of Gloucester. The upper and lower bound benefit value comparisons are also shown for illustrative purposes. As shown in Table 6, under each evaluation, project costs substantially exceed project benefits, even under the upper bound benefit value, resulting in benefit-cost ratios of less than one in all cases. No net NED benefit would result from the evaluated plan of improvement.

TABLE 6
GLOUCESTER HARBOR, MASSACHUSETTS
PROJECT JUSTIFICATION FOR 24-FOOT DEPTH

	Lower Bound	Mean Value	Upper Bound
Benefit Cost Analysis			
Annual Cost	$ 270,400	$ 270,400	$ 270,400
Annual Benefits	$ 73,700	$ 118,500	$ 163,300
Benefit/Cost Ratio	0.27	0.44	0.60
Net Annual Benefit	None	None	None

CONCLUSIONS

The New England Division, Corps of Engineers, has reviewed and evaluated, in the overall public interest, all pertinent data available at this level of analysis concerning the proposed plans of improvement, as well as the stated views of other interested agencies and concerned interests relative to the various practical alternatives for providing navigation improvements for Gloucester Harbor, Massachusetts, in the form of deeper entrance and access channels. The possible consequences of the alternatives have been evaluated on the basis of engineering feasibility and economic justification.

Benefits are found to be derived by providing the deeper draft vessels currently calling on the Port of Gloucester with improved and more efficient access to the harbor and its facilities at all stages of the tide, eliminating tidal delays and re-routing incidents. However, based on this reconnaissance study, the channel deepening proposal did not exhibit sufficient annual benefits to be considered economically justified. The plan for deepening Gloucester Harbor therefore can not serve as a basis for recommending Federal involvement in further feasibility level studies of proposed improvements to the harbor.

RECOMMENDATION

The Division Engineer recommends no further study of navigation improvements for deepening the main entrance and access channels at Gloucester Harbor, Massachusetts, at this time.

ACKNOWLEDGMENT AND IDENTIFICATION OF PERSONNEL

This report was prepared under the supervision and management of the following New England Division personnel:

Colonel Earle C. Richardson, Division Engineer
Joseph L. Ignazio, Director of Planning
Paul E. Pronovost, Deputy Director of Planning
John C. Craig, Chief, Formulation Division
Michael Keegan, Chief, Project Planning Branch

Study management and plan formulation for the project were conducted by the study manager, Mark L. Habel. Project design and cost estimates were prepared by Al Lemire. Economic Analysis was conducted by Karen Umbrell. Geotechnical evaluation was conducted by Rose Schmidt. Research on project history was conducted by Laureen Borochaner and Mark Habel. Graphics were by Mark Habel and Scott Flanagan.

GLOUCESTER HARBOR
GLOUCESTER, MASSACHUSETTS

NAVIGATION IMPROVEMENT STUDY

RECONNAISSANCE REPORT

APPENDIX A

PERTINENT CORRESPONDENCE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

GLOUCESTER HARBOR
GLOUCESTER, MASSACHUSETTS

APPENDIX A

PERTINENT CORRESPONDENCE

LIST OF MEETINGS WITH LOCAL INTERESTS

Meeting With City Officials and Harbor Interests - March 24, 1994
Meeting With Harbor Interests - October 25, 1993
Meeting With Mayor of Gloucester, State Representative and Harbor Interests - August 11, 1993

CORRESPONDENCE DURING RECONNAISSANCE INVESTIGATION

New England Division, Division Engineer, Memorandum to HQUSACE, July 28, 1995
New England Division, Division Engineer, Transmittal Letter to City, July 28, 1995
Captain F. R. Morton, Harbor Pilot - September 7, 1994
Elliott Stevedoring, Inc. - August 8, 1994
F. R. Morton Associates - August 4, 1994
New England Division, Director of Planning - July 25, 1994
Captain F. R. Morton, Harbor Pilot - July 22, 1994
New England Division, Director of Planning - July 5, 1994
Eimskip USA, Inc. - June 27, 1994
Seatrade Groningen B.V. - June 2, 1994
Samskip Shipping Company - June 1, 1994
Sunmar Shipping, Inc. - December 20, 1993
Captain F. R. Morton, Harbor Pilot - August 31, 1993
New England Division, Division Engineer - August 2, 1993
City of Gloucester, Mayor - July 8, 1993
Deputy Pilot Commissioner, District Two - June 30, 1993
Captain F. R. Morton, Harbor Pilot - June 28, 1993

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

CENED-PL-F (1105-2-100)

28 July 1995

MEMORANDUM FOR Commander, USACE (CECW-PE), ATTN: Chief, Policy and Planning Division, 20 Massachusetts Ave. NW, Washington, DC 20314-1000

SUBJECT: Completion of Section 107 Reconnaissance Study - Gloucester Harbor, Gloucester, MA - Navigation Improvement Study - CWIS #87765 (6th CD)

1. The New England Division has completed its reconnaissance study of the subject project under Section 107 of the 1960 River and Harbor Act, as amended. Federal assistance was requested by the city of Gloucester and the Massachusetts Deputy Pilot Commissioner in alleviating navigational access problems for cargo carriers calling on Gloucester facilities which resulted from a lack of adequate channel depth. The sponsoring local community and state agencies have been informed of the findings (copy of letter enclosed).

2. The evaluated project modifications consisted of alternative depth increases for the entrance channel, turning area and north branch channel, which have an existing authorized depth of -20 feet at mean low water (MLW). Increased depths of -24 and -26 feet MLW were evaluated. It was concluded that a depth of -24 feet MLW depth would alleviate nearly all the tidal access problems for vessels currently serving Gloucester. None of the shippers using Gloucester, all of which traffic in frozen food products, expressed any plans for increasing the size of vessels calling at Gloucester, even with a deepened channel. As transportation cost savings for Gloucester shippers were found insufficient to justify the lesser deepening, and no interest was expressed in taking advantage of any greater deepening, these plans were found not to be economically justified.

3. The reconnaissance study concludes that Federal involvement in further study of modifications to the main shipping channels of the existing Federal navigation project for Gloucester Harbor is not warranted at this time.

Encl

EARLE C. RICHARDSON
COL, EN
Commanding

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF
Planning Directorate
Formulation Division

July 28, 1995

Honorable Bruce Tobey
Mayor of Gloucester
Gloucester, Massachusetts 01930

Dear Mayor Tobey:

The New England Division has completed its reconnaissance study of navigational access problems of the main shipping channels in Gloucester Harbor. The study was conducted under the authority of Section 107 of the River and Harbor Act of 1960. The study concluded that further Federal involvement in modifying the existing Federal project, in the interest of commercial navigation, is not economically justified at this time.

Ten copies of the Reconnaissance Report are forwarded for the town's use and information. The report determined that the deepening of the harbor's entrance channel, inner harbor turning area and north branch channel from their current authorized depth of -20 feet at mean low water (MLW), to a depth of -24 feet MLW, would alleviate nearly all tidal inefficiencies now experienced by the larger cargo carriers calling at Gloucester facilities. A more extensive deepening of the harbor channels, to -26 feet MLW, was also examined on the premise that shippers would adjust the mix of vessels calling at Gloucester towards deeper draft craft if additional depth were provided.

It was concluded that the savings in transportation costs that would result from the deeper channels would be insufficient to offset the more than $3.3 million cost of construction and maintenance costs for the deepened channels. Additionally, none of the shipping interests contacted during the study indicated any specific plans to increase the size of vessels employed in the trade at Gloucester, even if deeper channels were provided.

The proposed project lacked sufficient economic benefits and was therefore determined not to be economically justified. Further Federal involvement in this project is therefore not warranted.

Should you have any further questions, the study manager for the investigation, Mr. Mark Habel, may be reached at (617) 647-8550.

Sincerely,

Earle C. Richardson
Colonel, Corps of Engineers
Division Engineer

Enclosures

Copies Furnished:

Mr. Michael P. Orlando
Deputy Pilot Commissioner, District Two
11 Church Street
Gloucester, Massachusetts 01930

Mr. Eugene F. Cavanaugh
Director of Waterways
Department of Environmental Management
100 Cambridge Street
Boston, Massachusetts 02202

Captain F.R. Morton
63 Longfellow Road
Reading, Massachusetts 01867

Mr. Chester J. Wizboski
Elliott Stevedoring, Inc.
P.O. Box 1189
Gloucester, Massachusetts 01930

Ms. Farrah Courtney
North Shore Regional Coordinator
Mass. Coastal Zone Management Office
State Fish Pier
Gloucester, Massachusetts 01930

Mr. Deerin Babb-Brott
Mass. Coastal Zone Management Office
100 Cambridge Street
Boston, Massachusetts 02202

F.R.MORTON ASSOCIATES
Marine Surveyors and Consultants
11 Pleasant Street
Suite 47
Gloucester, MA 01930
Tel: (508) 282-1534

F.R.M.

Karen Umbrell
Economist
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02254-9149

9/07/94

Dear Karen;

Enclosed please find the vessel moves for Gloucester from 1991 to 1994. I apologize for being so late with them but circumstances prevented me from getting them to you any sooner. As you can see from the last few months reports we are now entering all the info on computer so that should make things easier in the future.

Please keep in mind that you and any of your co-workers are more than welcome to ride out with the pilots to any of the vessels calling on Gloucester. Let me know any time you want to go with us. Thanks again for your understanding while waiting on the information.

Sincerely;

F.R. Morton

P.S. Enclosed also is a 1994 company brochure and an updated business card.

ELLIOTT
STEVEDORING

SHIP AGENTS—STEVEDORES

ELLIOTT STEVEDORING, INC. • P.O. BOX 1189 • GLOUCESTER, MA 01930

Gloucester Phone
508-281-1700

Nights & Sundays
508-921-0741

Cable Address
"Ellship" Boston

Telex
940727 (W.U.)

Fax
508-281-3065

August 8, 1994

Mr. Joseph L. Ignazio
Director of Planning
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear Mr. Ignazio

I received your letter requesting additional information in support of deepening Gloucester Harbor. I hope the following will assist you in your analysis.

Presently the vessels that serve Gloucester range from 350'-400' LOA, beam 51'-61' and draft of 21.6'-24'.

Most of the vessels that call at the Port of Gloucester do experience tidal delays. I would estimate that these delays occur approximately 75- 85 percent of the time. Average length is six hours.

Vessels do not currently light load but do at times use a less efficient routing or sequencing of port calls to avoid arriving at Gloucester with a deeper draft than the harbor is able to accommodate.

The trend is toward larger vessels, and it is certain that they would be sent to gloucester if the channel depth is increased.

Cargos have been landed in Bayside New Brunswick, Canada and trucked to Gloucester. It is believed that it is trucked at a cost of $110.00 per metric ton. Estimated revenue lost to Canada by Gloucester we believe to be $1,600,000.00 per year.

We at the Port of Gloucester thank you for your efforts, and remain available to assist as needed.

Sincerely

Chester J. Wizboski
ELLIOTT STEVEDORING, INC.

F.R.MORTON ASSOCIATES
Marine Surveyors and Consultants
11 Pleasant Street
Suite 47
Gloucester, MA 01930
Tel: (508) 282-1534

F.R.M.

Mr. Joseph L. Ignazio
Director of Planning
Army Corps of Engineers
424 Trapelo Rd.
Waltham, Mass. 02254-9149

8/04/94

Dear Mr. Ignazio;

In response to your letter of July 25 1994 Mr. Chet Wizboski of Elliott Stevedoring and myself have met and put together the following information which we hope will be of assistance to you.

Under Existing Navigation Conditions

A list of all vessels calling on Gloucester During the last three years is being prepared for Karen Umbrell. The list of ships will include information on Length overall, draft and tonnage.
Tidal delays are experienced by about 65% to 75% of the vessels calling on Gloucester. Most of the vessels Captains have been very cooperative in triming their ships as much as possible in order to minimize the delay. However some ships may experience as much as six hours delay.
Of the vessels calling on Gloucester most are light loaded in order to enter the port. Rogers St. pier has the greatest depth alongside at 24 feet and any vessel bound for Rogers St. with a draft of more than 18 feet will experience some delay if arriving at low water. Some vessels have had to call on Boston first in order to discharge enough cargo to enter Gloucester. Other South American vessels in the Seatrade group are calling on Puerto Rico first in order to lighten up enough to enter Gloucester. Calling on Gloucester first and then Puerto Rico is not an option for these vessels. Recently, one vessel bound for Gloucester could not enter at all due to a draft of 25 feet and 6 inches. This vessel diverted to Canada to discharge her cargo.

With a Deepened Navigation Channel System

Larger vessels in either Eimskip, Samskip or Seatrade as well as vessels in the Sakhalin Island Trade could enter if the channels were dredged to 26 feet at mean low water. Most of these vessels are 135 to 145 meters in length with maximum drafts of 24 to 26 feet and displace approximately 10,000 tons.

Additional cargoes could be loaded here or greater loads of cargo might be imported that are currently being lost to Canada. The benefits are lower costs to the consignees of these cargoes as well as additional work generated here in Gloucester instead of Canadian ports.

Lastly the shipping here in Gloucester would greatly benefit from dredging by allowing the container lines greater flexibility in utilizing Gloucester. This past year the port has been successful in attracting a major shipping line, Eimskip U.S.A., to Gloucester. With the present depth limits we are barely able to accomodate them now. If Eimskip plans to put bigger ships on this run, Gloucester will not be able to handle them. With a greater depth here and the committment of the dock owners to improve the piers as well as improve dockside depths Gloucester can compete against southern Canadian ports. These improvements along with the nearby interstate highway system will make Gloucester very attractive to shippers.

Thank you for your time in this regard.

Sincerely;

F.R. Morton

cc/file

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

July 25, 1994

Planning Directorate
Impact Analysis Division

Mr. Chet Wyzboski
Elliot Stevedoring Inc.
20 Main Street
Gloucester, MA 01930

Dear Mr. Wyzboski

Thank you for the assistance and information which you have already provided regarding shipping activities and navigation problems in Gloucester Harbor. In order to complete our analysis of the economic benefits of deepening the harbor, we would like to request additional information regarding the operations of both the Seatrade vessels and the Samskip vessels. Letters written to us by both Seatrade and Samskip in support of deepening the harbor referred us to you for any requests for additional information. We would greatly appreciate responses to the following questions for both Seatrade and Samskip.

Under Existing Navigation Conditions
- What vessels do you currently use to serve Gloucester Harbor and what are the dimensions (deadweight tonnage, length, loaded draft, beam) of these vessels?
- Do your vessels currently experience tidal delays getting into or out of Gloucester Harbor, and, if so, what is the average length of such delays, and on what percentage of your trips to Gloucester is a tidal delay encountered?
- Do you currently light-load your vessels in order to call on Gloucester, or do you currently use a less efficient routing or sequencing of port calls to avoid arriving at Gloucester with a deeper draft than the harbor can accommodate?

With a Deepened Navigation Channel System
- Would you switch to larger vessels if the channel depth were increased? If yes, then what would be the dimensions (deadweight tonnage, length, loaded draft and beam) of the likely new vessels that you would use?
- Would you ship additional cargos into Gloucester Harbor that may now be landed elsewhere at a greater transportation cost, and if so, what benefit would you expect to gain?

- Please advise us of any other means by which you may expect that your shipping operations would benefit from an increase in the channel depth at Gloucester Harbor.

We will greatly appreciate any information which you can provide. If you have any questions regarding the information requested, please contact the study Economist, Karen Umbrell, at (617) 647-8140.

Thank you very much for your time and assistance.

Sincerely,

Joseph L. Ignazio
Director of Planning

Copy Furnished:

Capt. Frank R. Morton
Harbor Pilot
63 Longfellow Road
Reading, MA 01867

F.R.MORTON ASSOCIATES
Marine Surveyors and Consultants
11 Pleasant Street
Suite 47
Gloucester, MA 01930
Tel: (508) 282-1534

07/22/94

Karen Umbrell
Economist
U.S. Army Corps of Engineers
424 Trapelo Rd.
Waltham, Ma. 02254-9149

Dear Karen;

Enclosed please find reports for vessels calling on Gloucester for 1990 as well as the more recent reports. The 1990 report is enclosed to highlight the difference in the ships arriving in Gloucester now as compared to four years ago. As you can see most of the vessels arriving back in 1990 were small enough to arrive and sail at any stage of the tide.

Now most of the ships must wait until low tide has past and in some cases these ships can only be docked or undocked at the time of maximum high tide.

On a separate page I have detailed some of the specific vessels that have incurred delays as a result of waiting for tide. The pilots do not normally maintain records on the length of a ship calling on the port but most ships arriving in Gloucester until recently were between 65 and 100 meters length overall. Most of the vessels arriving today are between 100 and 130 meters length overall.

I hope this information will be of assistance to you. Please feel free to contact me if you have any questions.

Sincerely;

F.R. Morton

cc/file

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

July 5, 1994

Planning Directorate
Coastal Development Branch

Mr. D. C. Courtney
Liner Services Manager
EIMSKIP USA, Inc.
100 East Main Street - Suite 500
P.O. Box 3598
Norfolk, Virginia 23514

Dear Mr. Courtney:

I am writing in response to your letter of June 27, 1994 concerning the New England Division's ongoing study of improvements to the navigation channels at Gloucester Harbor, Massachusetts, as proposed by the City of Gloucester and the Massachusetts Pilots Commissioner.

In answer to your questions regarding channel conditions in the main shipping channels at Gloucester Harbor the following information is provided:

The existing Federal navigation project for Gloucester calls for a depth of -20 feet at mean low water in the main entrance channel, turning basin and both the north and south branch channels in the inner harbor (see the attached map). The project was completed in 1965. Depths in the channel have remained stable over the years and no maintenance dredging has been required since completion. A copy of the latest condition survey of the channels from 1986 is also attached (2 sheets). The U.S. Coast Guard publishes regular notices on navigation conditions for harbors, including minimum depths present in major channels. It is suggested that you contact the Coast Guard's Marine Safety Office in Boston for more detailed information on navigation conditions at Gloucester Harbor.

The responsibility for monitoring and maintaining depths in berthing areas alongside dockage facilities rests with the owners of such facilities and is not a Corps responsibility. We suggest that you contact Americold directly for this information.

Tidal ranges at Gloucester Harbor, as listed in the U.S. Department of Commerce Tide Tables are 8.7 feet (mean) and 10.1 feet (spring).

The New England Division is presently conducting a reconnaissance study of the improvements proposed by local officials for Gloucester Harbor. It has been proposed that the main entrance channel, turning area, the north inner harbor branch channel and the southern reach of the south branch channel be deepened from the authorized 20-foot depth to depths of up to -26 feet MLW. For the Federal government to justify further participation in advanced studies of this proposal and any future construction, it must be determined that such a project is economically justified. The economic benefit gained by multiple users of the harbor due to a deepened channel system must outweigh the costs of constructing and maintaining a deeper harbor. In order to assist us in making this determination, it is requested that you provide us with the following information:

Under Existing Navigation Conditions

- What commodities and quantities do you ship into Gloucester Harbor?
- How many trips per month do you make, on average, to Gloucester Harbor?
- What vessels do you currently use to serve Gloucester Harbor and what are the dimensions (length, loaded draft, beam) of these vessels?
- Do your vessels currently experience tidal delays getting into or out of Gloucester Harbor, and if so, what is the average length of such delays, and on what percentage of your trips to Gloucester is a tidal delay encountered?
- Do you currently light-load your vessels in order to call on Gloucester, or do you currently use a less efficient routing or sequencing of port calls to avoid arriving at Gloucester with a deeper draft than the harbor can accommodate?

With a Deepened Navigation Channel System

- Would you switch to larger vessels if the channel depth were increased? If yes, then what would be the dimensions (length, loaded draft and beam) of the likely new vessels that you would use?
- Would you ship additional cargos into Gloucester Harbor that may now be landed elsewhere at a greater transportation cost, and if so, what benefit would you expect to gain?
- Please advise us of any other means by which you may expect that your shipping operations would benefit from an increase in the channel depths at Gloucester Harbor.

Should the reconnaissance study determine that such improvements may be economically justified, then a feasibility study of the proposed improvements would be recommended, provided that a non-Federal public agency was willing to share in the cost of such a study. The feasibility study would be the final planning effort prior to any construction and would include detailed engineering investigations and design, environmental studies and permitting and further economic evaluations.

The reconnaissance study for Gloucester Harbor is expected to be completed by December 1994. Feasibility studies and other preparations for construction generally take about 24 months.

If you have any further questions concerning this study, please contact the project manager, Mr. Mark Habel, at (617) 647-8550.

Sincerely,

Joseph L. Ignazio
Director of Planning

Enclosures

Copy Furnished:

Capt. Frank R. Morton
Harbor Pilot
63 Longfellow Road
Reading, MA 01867

EIMSKIP
USA INCORPORATED

109 East Main Street - Suite 500
P.O. Box 3698
Norfolk, Virginia 23514
Tel: (804) 627-4444
Toll Free: (800) 446-8317
Telex: 6844411
Telefax: (804) 627-9367

June 27, 1994

Mr. Mark Habel
Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Habel:

We are agents representing EIMSKIP/The Iceland Steamship Company Ltd. Our principal provides fortnightly container service to the port of Gloucester (Americold - Rowe Square) and consequently, is interested in obtaining accurate information regarding present port conditions. Please confirm the following:

1) Minimum depth on mean low water from channel entrance through the channel straight towards Americold Rowe Square.

2) Minimum dept on mean low water alongside Americold Row Square for vessels of LOA 400 feet.

3) The variance between flood and ebb tides in the habor of Gloucester.

In addition to present port conditions, our principal is also so very much interested in any plans for improvements to the Gloucester harbor. It is our understanding that an application has been filed to deepen the channel to 26 feet. Can you confirm if such application has been made and can you offer any advice on when dredging may begin?

As agents representing EIMSKIP and their liner service into Gloucester, we believe channel improvements are vital to the continued growth of the port and fully endorse any plans for such action.

Sincerely,
EIMSKIP USA, INC.

D. C. Courtney
Liner Services Manager

cc: Mr. Asbjorn Skulason - EIMSKIP Reykjavik
Mr. Gardar Thorsteinsson - EIMSKIP USA, INC.

Seatrade

Owners and managers of refrigerated vessels

Seatrade Groningen B.V.
Laan Corpus den Hoorn 200, Groningen-Zuid
Postal address:
P.O. Box 858, 9700 AW Groningen, The Netherlands

Telephone (31)50-265888
Telex 53034 seat nl.
Telefax (31)50-261683
Cables 'Seatrade Groningen'
Handelsregister K.v.K. Groningen No. 50641

ING Bank No. 67.01.41.410
ABN-AMRO No. 57.06.39.298
Postbank 890143
BTW nr. NL 8002.65.579.B02

Mr. Joseph L. Ignazio
Director of Planning
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Mass 02254-9149
U.S.A.

Your ref: Our ref: TCRT/me Groningen, 2 June, 1994

Re.: **Dredging of the port of Gloucester, Mass**

Dear Sir,

We are a Dutch shipowning and shipmanagement company operating 50 refrigerated vessels. Together with the commercial operators of our vessels (Scaldis Reefer Chartering NV), some 95 refrigerated vessels are being scheduled around the world.

Since many years (in fact since 1965) we have carried hundreds of cargoes of frozen fish to the port of Gloucester, Mass from countries in Europe, Canada, Greenland, Argentina, Uruguy etc. during which time Elliott Stevedoring Inc has always been handling our ships.

Still today our vessels are calling at Gloucester, Mass approx once every three weeks.

We understand that you are presently studying the possibility of increasing the depth of the North, South and Main Channels from 20 to 26 feet at mean low water.
Whilst the present 20 feet draft limitation has generally been acceptable during many years, during the last five years or so, during which sizes of ships have increased, the 20 feet draft has often created waiting times for the ships.

For this reason we would strongly support not only the above dredging but also the dredging of the port of Gloucester, Mass. enabling this important entry port of frozen fish in the United States to continue to also receive the refrigerated vessels of today.

If you should require any further information on our vessels please feel free to contact us or our above mentioned local Agents : Elliott Stevedoring Inc.

Yours sincerely,
Seatrade Groningen B.V.

po

Tom C.R. Tammes
President

c.c.: Mr Frank Elliott of Elliott Stevedoring Inc

Ingvar Sigurosson
Samskip Shipping Company
Holtabakka Vid Holtaveg 104
Reykjavik, Iceland

June 1st 1994

Mr. Joseph L. Ignazio
Director of Planning
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham , Massachusets 02254 - 9149

RE: DREDGING GLOUCESTER HARBOUR

Dear Sir,

Samskip is an Icleandic Shipping and Transportation Copmany located in Reykjavik Iceland We are ship owners and operators, and we transport cargoes of frozen fish from Iceland destined to Gloucester and for further distribution to other U.S. destinations.

We have been advised by the Gloucester pilots that the U.S. Army corps of engineers is studying a proposal to dredge the main, north and south channels from the present 20 feet to 26 feet at mean low water. We strongly support the plan to increase the depth of the Gloucester harbor. Our vessels have many times been delayed waiting for high tides for entering or departing the Gloucester harbor. Further, the present limited draft of 20 feet restricts the type and size of vessel which we can use to serve Gloucester. An increased harbor depth would give us much more flexibility for continuing our service of delivery and distribution of frozen seafood products throught the port of Gloucester.

Elliot Stevedoring serves as agents when our vessels call at Gloucester, and they can give you any further information about our vessel activities at the port of Gloucester.

Sincerely,
SAMSKIP SHIPPING COMPANY

Ingvar Sigurðsson ,
Director of liner operations

cc: Elliott Stevedoring Mr. Frank Elliott.

SUNMAR SHIPPING, INC.
SHIPOWNERS • OPERATORS • BROKERS

TELEPHONE 206-443-0200
TELEFAX 206-443-0207
2615 FOURTH AVE., SUITE 700
SEATTLE, WA 98121 USA

DECEMBER 20, 1993

MR. JOSEPH L. IGNAZIO
DIRECTOR OF PLANNING
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

RE: DREDGING GLOUCESTER HARBOR

DEAR SIR,

SUNMAR SHIPPING, INC. IS A U.S. COMPANY DOMICILED IN SEATTLE. WE ARE SHIP OWNERS AND OPERATORS, AND WE FREQUENTLY CARRY CARGOES OF FROZEN FISH FROM THE NORTH PACIFIC OCEAN DESTINED TO GLOUCESTER AND FOR FURTHER DISTRIBUTION TO OTHER U.S. DESTINATIONS.

WE HAVE BEEN ADVISED BY THE GLOUCESTER PILOTS THAT THE U.S. ARMY CORPS OF ENGINEERS IS STUDYING A PROPOSAL TO DREDGE THE MAIN, NORTH AND SOUTH CHANNELS FROM THE PRESENT 20 FEET TO 26 FEET AT MEAN LOW WATER. WE STRONGLY SUPPORT THE PLAN TO INCREASE THE DEPTH OF THE GLOUCESTER HARBOR. OUR VESSELS HAVE MANY TIMES BEEN DELAYED WAITING FOR HIGH TIDES FOR ENTERING OR DEPARTING THE GLOUCESTER HARBOR. FURTHER, THE PRESENT LIMITED DRAFT OF 20 FEET RESTRICTS THE TYPE AND SIZE OF VESSEL WHICH WE CAN USE TO SERVE GLOUCESTER. AN INCREASED HARBOR DEPTH WOULD GIVE US MUCH MORE FLEXIBILITY FOR CONTINUING OUR SERVICE OF DELIVERY AND DISTRIBUTION OF FROZEN SEAFOOD PRODUCTS THROUGH THE PORT OF GLOUCESTER.

ELLIOT STEVEDORING SERVES AS AGENTS WHEN OUR VESSELS CALL AT GLOUCESTER, AND THEY CAN GIVE YOU ANY FURTHER INFORMATION ABOUT OUR VESSEL ACTIVITIES AT THE PORT OF GLOUCESTER.

SINCERELY,
SUNMAR SHIPPING, INC.

Joseph G. Erickson

JOSEPH G. ERICKSON
VICE PRESIDENT

CC: GLOUCESTER PILOTS - MR. F.R. MORTON
ELLIOT STEVEDORING - MR. FRANK ELLIOT

Mr. John T. Smith, P.E.
Civil Engineer
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear Mr. Smith 8/31/93

On behalf of the Pilot Commissioner, Mr. Orlando, and myself, I want to take this opportunity to thank both you and Ms. Karen Umbrell for meeting with us in Gloucester on August 11.

Your insight and and experience was most beneficial to us and we appreciate your thoughts on how best to proceed with the project.

As I mentioned at the meeting I am most happy to act as the first point of contact for you and your staff in arranging meetings or for any other matter. Please let me know if there is anything else that I can do to assist you in the Reconnaissance Study.

Again, thank you for your kind assistance in this matter.

Sincerely;

F.R. Morton

F.R. Morton
63 Longfellow Rd.
Reading, Mass. 01867

cc: Ms. Karen Umbrell

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

02 AUG 1993

Planning Directorate
Coastal Development Branch

Mr. Michael P. Orlando
Deputy Pilot Commissioner
District Two
11 Church Street
Gloucester, Massachusetts 01930

Dear Mr. Orlando:

I am writing in the temporary absence of Colonel Brink P. Miller, in response to your letter of June 30, 1993 concerning Gloucester Harbor, Massachusetts. Mr. John Smith and Ms. Karen Umbrell, of my staff will be meeting with you on August 11 to discuss your request for deepening of the harbor channels.

The existing Federal navigation project for Gloucester Harbor provides an authorized channel depth of 20 feet at mean low water in the main entrance channel and in the two branch channels into the north and south channels of the inner harbor. As you have indicated, our most recent hydrographic surveys show that the harbor channels have generally maintained this depth since the project's completion in 1965. Maintenance of the channel to the authorized depth when necessary is the responsibility of the Federal government. Deepening of the harbor channels beyond the authorized 20-foot depth as you propose would require studies in support of a new authorization.

The Corps examines proposed project modifications such as this through a two phase study process. The first phase, a Federally funded Reconnaissance Study, would determine if the proposed improvement warrants a full scale feasibility study through an initial examination of the project's cost, economic justification and environmental acceptability. If a Reconnaissance Study determines that further study efforts are warranted, then a Feasibility Study would be undertaken, and cost-shared at 50 percent with a non-Federal public sponsor. Reconnaissance studies are generally completed within 12 months, while feasibility studies are generally completed within 18 months.

Two methods for authorizing and funding such studies exist. Section 107 of the River and Harbor Act of 1960, as amended, provides the Corps with the authority to share in the cost of studying and constructing projects with a Federal cost limit of $4 million. For projects where Federal costs would exceed $4 million, specific Congressional authorization and funding is required. Based on past history, costs for channel deepening at Gloucester would be expected to be highly dependent on the amount of ledge removal required.

After the meeting on August 11, my staff will evaluate your proposed improvements to the project and make recommendations on whether and how to proceed with an investigation. If you have any further questions, please contact me at (617) 647-8230 or Mr. John Smith at (617) 647-8528.

Sincerely,

William C. Scully
Acting Division Engineer

Copies Furnished:

Captain F.R. Morton
63 Longfellow Road
Reading, MA 01867

Honorable William S. Rafter, Jr.
Mayor of Gloucester
City Hall
Gloucester, MA 01930

CITY OF GLOUCESTER

GLOUCESTER · MASSACHUSETTS · 01930

OFFICE OF THE MAYOR

July 8, 1993

Colonel Brink Miller
Corp. of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Miller:

It has come to my attention recently that Gloucester Harbor has been at a competitive disadvantage due to shallow shipping channels. I'm informed if our shipping channels could be improved from the current 20 ft. depth at low water to 26 feet at low water, we would be able to bring larger vessels into our port.

As you may know the City of Gloucester has one of the highest unemployment rates in the Commonwealth. As Mayor, I am committed to do everything in my power to increase our economic strength. The harbor, through fishing, and other commerce is our lifeline for survival.

Colonel, if I can assist you in any way toward the improvement of this important resource, please contact me.

Sincerely,

William S. Rafter, Jr.
Mayor

cc: Mike Orlando
11 Church Street
Gloucester, MA 01930

Telephone 283-3937
283-1167 —

DEPUTY PILOT COMMISSIONER, DISTRICT TWO

Ports of Salem, Beverly, Marblehead, Gloucester and Newburyport

MICHAEL P. ORLANDO
11 CHURCH STREET
GLOUCESTER, MASS. 01930

Colonel Brink Miller
Corp of Engineers
424 Trapelo Road
Waltham Mass. 02254-9149

Dear Colonel Miller,

June 30 1993

As the recently appointed Deputy Pilot Commissioner, District Two, Commonwealth of Massachusetts, I write in the hope that you can assist the port of Gloucester, specifically in the dredging of this harbor.

From conversations with pilots and operators in Gloucester I understand that the harbor is maintained to twenty feet at low water. It has stayed at this depth for many years now. During recent years we have lost out on the opportunity to bring in new and more ships due to the limited depth in the main shipping channels.

I would very much like to see the harbor dredged to twenty six feet at low water. This depth would allow the port to compete with other small ports such as Portsmouth N.H., Portland and Searsport Me. as well as small ports in R.I.

If a meeting could be arranged for a time convenient to your schedule I would gladly offer my office as a site for that meeting. Please let me know if this is possible and I will make the pilots and operators in Gloucester aware of the time so that they may voice their opinions and concearns at that time.

I look forward to hearing from you and working with you in the near future.

Sincerely;

Michael P. Orlando

Michael P. Orlando
Deputy Pilot Commissioner
District Two
11 Curch St.
Gloucester Mass. 01930

Colonel Brink Miller
Commander
Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Mass.02254-9149

Dear Colonel Miller, June 28 1993

During the past few weeks there have been numerous discussions between pilots and agents and operators in the port of Gloucester regarding depth of water in the main shipping channels and alongside the four principle cargo docks.

Presently the main channels are maintained to 20 feet at mean low water with varying depths alongside the piers. As vessels have increased in size during recent years the present depth is insufficient to the needs of shipping companies calling on Gloucester or intending to add Gloucester as a port of call. There have been numerous instances of vessels wanting to enter but the drafts of these vessels have been in the 24 feet to 26 feet range.

It is the opinion of the operators, agents and myself that a depth of 26 feet at mean low water would be adequate to meet the needs of the port. This depth would not only meet present needs but would be sufficient to allow for expansion of the port services.

It would be greatly appreciated if a small group of people from Gloucester could meet with you at some time in the near future to discuss the possibility of dredging the harbor. Please feel free to contact me at any time to arrange a meeting.

Thanking you in advance for your kind attention to this matter.

Sincerely;

Captain F.R. Morton
63 Longfellow Rd.
Reading Mass. 01867
617 944 6912

GLOUCESTER HARBOR
GLOUCESTER, MASSACHUSETTS

NAVIGATION IMPROVEMENT STUDY

RECONNAISSANCE REPORT

APPENDIX B

DESIGN AND COST ESTIMATES

PREPARED BY:

Coastal Engineering & Survey Branch
Design Division
Engineering Directorate

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

TABLE OF CONTENTS

LIST OF PLATES

GLOUCESTER HARBOR
MASSACHUSETTS
MAIN SHIP CHANNEL

1. Study Area:

The community of Gloucester, Massachusetts is located about 25 miles northeast of Boston along the northern coast of Massachusetts. It is situated along the southern coast of the Cape Ann peninsular and is boarded by the towns of Rockport, Manchester, and Essex. Gloucester Harbor is made up of an Outer Harbor, so called, and an Inner Harbor (see Plates-B1 and -B2). The Outer Harbor includes the Western Harbor and the Southeast Harbor, and lies along a south-southwest axis. The Inner Harbor is boarded by Harbor Cove and Smith Cove, and lies along a southwest axis; it also includes a federally authorized navigation project.

2. Federal Navigation Project:

The major features of this authorized project are an entrance channel with a 600-foot turning basin, and 2 access channels to each side of the Gloucester Fish Pier (North and South Channels, so called), all authorized to a depth of 20 feet below mean low water (mlw). There are also 2 side channels for access to Harbor Cove and Smith Cove authorized to 18 feet and 16 feet below mlw, respectively; and 2 anchorages authorized to 15 feet and 16 feet below mlw.

3. Study Investigation:

Two project depths were proposed for investigation: 24 feet and 26 feet below mlw. These depths were based on the channel being used by a Trawler/Processing ship with a length of 490 feet, a beam of 60 feet and a draft of 21 to 22 feet. For this size vessel, it was determined that the width of the channel and the size of the turning basin would need to be checked to insure adequacy. Based on the existing and future commercial needs of the area, one-way traffic was determined to be sufficient and only the North Channel and Entrance Channel in the Inner Harbor were investigated for deepening. In the Outer Harbor, the existing Federal Channel was found to need extending out into deeper waters.

4. Channel Width:

The channel widths required were investigated using the criteria described in reference 1. It was determined that for a vessel with a beam of 60 feet and poor controllability, that the bank clearance and maneuvering lane requirements would not exceed the existing Federally authorized channel width of 300 feet. It was therefore determined to continue using this width for both the existing Federal Channel and for the proposed new channel extension into the Outer Harbor.

5. Alignment:

As stated earlier, the axes of the Outer and Inner Harbors do not coincide. However, their alignments are within 26 degrees of each other. It was decided to incorporate this 26 degree bend by using the Apex Method (ref. 1.). This action does not involve any physical changes to be made. Therefore, no adverse effects on existing currents would be produced as a result of using this method for channel alignment.

6. Turning Basin:

No significant velocity changes are expected, either as a result of the increasing channel depth or from the dredging of the turning basin. Consequently, it was decided that the size of a turning basin could be established using 150% of the length of the design vessel. It was determined that a diameter of 750 feet was sufficient to accommodate the design vessel used for this study. Also, based on previous maintenance efforts performed for the existing project (the last maintenance dredging was done in 1958), shoaling is not considered to be a problem. Therefore, a provision for additional depth in the area of the turning basin was not felt to be necessary. The placement of the turning basin at the junction of the Entrance Channel, with the North and South Channels in the area of the existing 16-foot anchorage, will require traffic control measures during the times it is used. However, due to the one-way traffic in the channel, traffic control requirements should not be overly restrictive.

7. Anchorage:

No new anchorages are being proposed in this study. However, approximately 1.8 acres of anchorage would be lost due to channel realignment along the North Channel, and approximately 3.6 acres would be lost due to the creation of the proposed turning basin.

8. Dredging:

Ten areas have been identified that are thought to require rock removal. They are shown on Plate B-3. All other dredge material is felt to be made up of hard sandy material; possibly a glacial till or a firm clay. The depths of dredging [all specified in terms of feet below mean low water (mlw)] will be to 24 feet and 26 feet with an allowable over-depth dredging to 26 feet and 28 feet, respectively, in earth. In rock, the depth will be 25 feet and 27 feet with an allowable over-depth dredging of 27 feet and 29 feet, respectively (ref. 1). For report and discussion purposes, the use of the project depths of 24 and 26 feet shall be all inclusive meaning that the 25- and 27-foot depths in rock are included as well.

9. Dredging Volumes:

Plates B-1 and B-2 show the proposed navigation improvements. The surface contours were developed for the Inner Harbor from a sounding survey, performed during March/April 1994, and shown on Plate B-3. For the Outer Harbor, the surface contours were developed from NOAA Coastal Chart, #13281, dated 26 December 1992. Both rock and ordinary material dredging volumes were obtained by using the CAD program "IN-ROADS." The rock quantities were calculated from contours provided by NED's Geotechnical Engineering Division. The dredging volumes are as follows:

ORDINARY MATERIAL:

DEPTH FT. (MLW)	VOLUME (CY)	OVER-DEPTH (CY)	TOTAL (CY)
24	162,275	129,752	292,027
26	292,027	168,188	460,215

ROCK:

DEPTH FT. (MLW)	VOLUME (CY)	OVER-DEPTH (CY)	TOTAL (CY)
25	5,277	3,684	8,961
27	8,961	5,407	14,368

For the purpose of cost estimating, the volumes used were rounded off to 292,000 and 460,000 CY in ordinary material, and 9,000 and 14,400 CY in rock, for a total dredge quantity of 301,000 and 475,000 CY for the 24-foot and 26-foot project depths, respectively.

10. Maintenance Dredging:

As stated previously, the Inner Harbor has an existing Federal navigation project. As such, a portion of the material that will be removed to construct the improvement project is chargeable to maintenance dredging of the existing project as authorized in reference 3. The volume of maintenance dredging is 70,150 CY of ordinary material. This volume was removed from the total volume of ordinary dredge material in making the estimate of total project cost.

11. Estimated Project Cost:

The project costs were developed using the volumes shown above and applied to the U.S. Army Corps of Engineers computer program Mechanical Dredge Estimating Program (CEMDEP) and the NED computer program Mechanical Dredge Estimating in Rock, which is a modification of CEMDEP. The first costs of construction, for improvement dredging only, rounded off to the nearest $1,000 and

including a 15% contingency to cover variations in site and weather conditions, are:

Project Depth	FT. (MLW)	24.....$3,049,000
		26.....$4,709,000.

These costs do not include project engineering and design or construction contract administration.

12. Construction:

The time to complete the construction of the proposed work, without allowances for environmental consideration or other factors such as harbor traffic, etc., is 3.2 months for the 24-foot project and 5.1 months for the 26-foot project. In both cases, the drilling and blasting work can be accomplished within the time stated and can be done concurrently with the dredging work.

13. REFERENCES:

a. EM 1110-2-1613, 8 April 1983, Hydraulic Design of Deep-Draft Navigation Projects, U.S. Army Corps of Engineers

b. ER 1130-2-307, 31 October 1968, Dredging Policies and Practices, U.S. Army Corps of Engineers

c. ER 1165-2-131, 15 April 1989, Local Cooperation Agreements for New Start Construction Projects, Appendix G, U.S.Army Corps of Engineers

PROJECT	Gloucester Harbor Ship Channel
FEATURE	Improvement Dredging, Project Depth 24'
IA,RECON,DFR,F&S,Other	RECON, SECTION 107
DATE PREPARED	12-May-95
ESTIMATOR	AHL
	MECHANICAL DREDGE

ITEM	QUANTITY	UNITS	UNIT PRICE	TOTAL COST
Dredging	231,000	CY	$6.35	$1,466,850
Mobilization/Demobilization	1	Job	LS	$284,500
Drilling and Blasting Rock	9,000	CY	$100.00	$900,000
SUBTOTAL				$2,651,350
Contingencies	15 %			$397,703
SUBTOTAL				$3,049,053
Pre-Constuction Engineering & Design (PED)				$74,947
Construction Management (CM)				$190,000
				$3,314,000

NOTES:

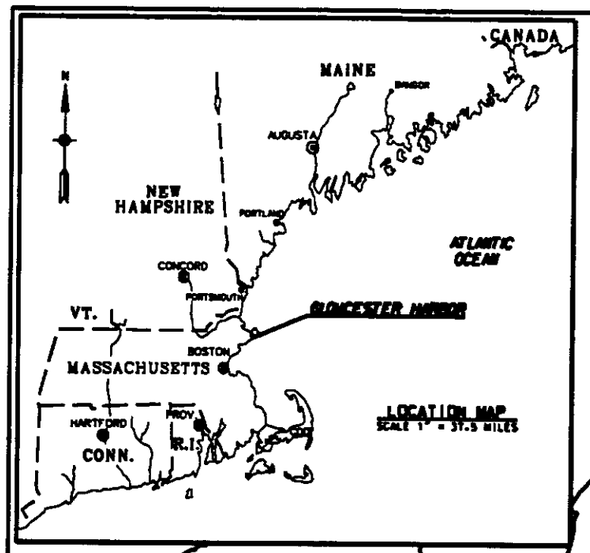
1. Estimated construction time 3.2 months.
2. Dredging is accomplished using a Mechanical Dredge with a 10 CY bucket working one, 12 hour shift 6 days a week.
3. Quantities include 2 foot of overdredge for ordinary material an rock; however, the required depth for rock is 25 ft. below mlw. The dredging volume has been adjusted to include only new work with approx. 70,000 cy removed to cover maintenance dredging. Disposal is to the Mass. Bay Disposal Site.
4. The unit costs shown include overhead, bond, and profit.
5. Contingencies include variabilities in weather and site conditions.
6. Volumes were computed from contours produced from a '94 condition survey and from a NOAA chart(#13281, 25 Dec.92), and rock surfaces were defined by GED.
7. PED includes Engineering During Construction (EDC) which is estimated at 1% of the construction cost. Plans & Specifications cost is PED minus EDC.
8. Costs shown do not include subsurface exploration or environmental costs as these are to be provided under a separate report by others.

PROJECT	Gloucester Harbor Ship Channel
FEATURE	Improvement Dredging, Project Depth 26'
IA,RECON,DPR,F&S,Other	RECON, SECTION 107
DATE PREPARED	12-May-95
ESTIMATOR	AHL
	MECHANICAL DREDGE

ITEM	QUANTITY	UNITS	UNIT PRICE	TOTAL COST
Dredging	405,000	CY	$6.35	$2,571,750
Mobilization/Demobilization	1	Job	LS	$284,500
Drilling and Blasting Rock	14,400	CY	$86.00	$1,238,400
SUBTOTAL				$4,094,650
Contingencies	15 %			$614,198
SUBTOTAL				$4,708,848
Pre-Constuction Engineering & Design (PED)				$131,152
Construction Management (CM)				$324,000
				$5,164,000

NOTES:

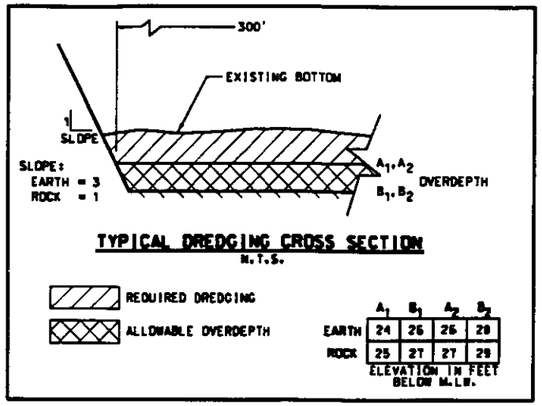
1. Estimated construction time 5.1 months.
2. Dredging is accomplished using a Mechanical Dredge with a 10 CY bucket working one, 12 hour shift 6 days a week.
3. Quantities include 2 foot of overdredge for ordinary material an rock; however, the required depth for rock is 27 ft. below mlw. The dredging volume has been adjusted to include only new work with approx. 70,000 cy removed to cover maintenance dredging. Disposal is to the Mass. Bay Disposal Site.
4. The unit costs shown include overhead, bond, and profit.
5. Contingencies include variabilities in weather and site conditions.
6. Volumes were computed from contours produced from a '94 condition survey and from a NOAA chart(#13281, 25 Dec.92), and rock surfaces were defined by GED.
7. PED includes Engineering During Construction (EDC) which is estimated at 1% of the construction cost. Plans & Specifications cost is PED minus EDC.
8. Costs shown do not include subsurface exploration or environmental costs as these are to be provided under a separate report by others.



NOTES:

1. ALL SOUNDING INFORMATION SHOWN ON THIS SHEET IS FROM NOAA CHART 13281 DATED 26 DECEMBER 1986.
2. EXISTING CHANNEL LIMITS SHOWN THUS: ——— PROPOSED CHANNEL LIMITS SHOWN THUS: — — —
3. AREA OF PROPOSED IMPROVEMENTS SHOWN THUS: ▨
4. NO DREDGING WILL BE REQUIRED IN THE NEW OUTER HARBOR EXTENSION CHANNEL.

GLOUCESTER HARBOR
MASSACHUSETTS
MAIN SHIP CHANNEL
INNER AND OUTER HARBOR
PROPOSED NAVIGATION IMPROVEMENTS



TYPICAL DREDGING CROSS SECTION
N.T.S.

REQUIRED DREDGING

ALLOWABLE OVERDEPTH

	A_1	B_1	A_2	B_2
EARTH	24	26	25	28
ROCK	25	27	27	29

ELEVATION IN FEET BELOW M.L.W.

N 590000

E 824000

E 826000

N 588000

N 586000

E 824000

E 826000

ROWE SQUARE WHARF

STATE PIER

ROGERS ST. WHARF

NORTH CHANNEL

SOUTH CHANNEL

U.S. COAST GUARD

HARBOR COVE

15 - FOOT ANCHORAGE

15 - FOOT CHANNEL

FORT POINT

15 - FOOT CHANNEL

ROCKY NECK

SMITH COVE

10 FOOT CHANNEL

N

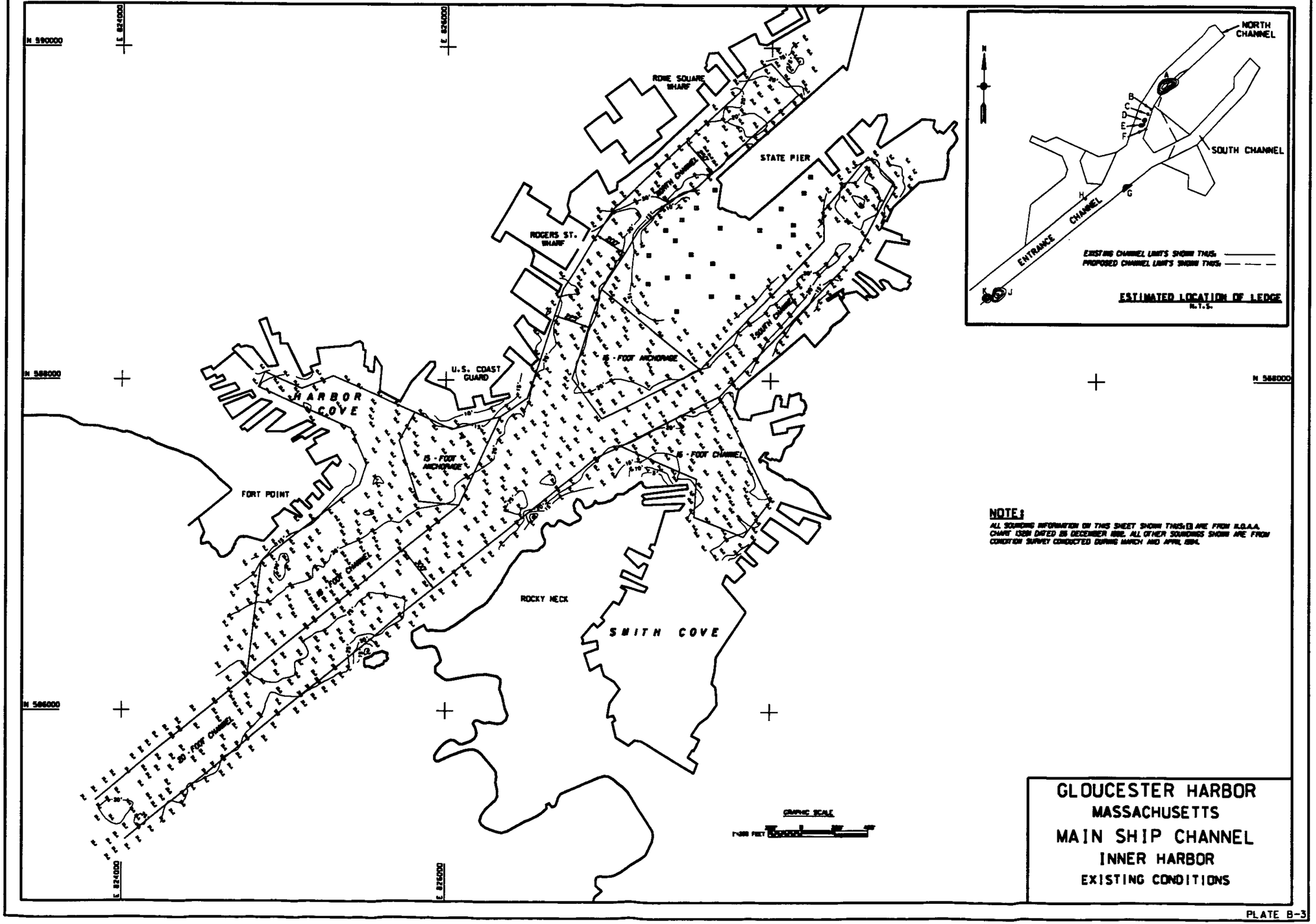
GRAPHIC SCALE

NOTES:

1. EXISTING CHANNEL LIMITS SHOWN THUS: ———
   PROPOSED CHANNEL LIMITS SHOWN THUS: — —
2. PORTION OF EXISTING PROJECT AND PROPOSED IMPROVEMENTS REQUIRING IMPROVEMENT DREDGING SHOWN THUS:

GLOUCESTER HARBOR
MASSACHUSETTS
MAIN SHIP CHANNEL
INNER HARBOR
PROPOSED CHANNEL IMPROVEMENTS

PLATE B-2



NOTE:
ALL SOUNDING INFORMATION ON THIS SHEET SHOWN THUS:(0) ARE FROM U.S.C.& G.S. CHART 1209 DATED 25 DECEMBER 1982. ALL OTHER SOUNDINGS SHOWN ARE FROM CONDITION SURVEY CONDUCTED DURING MARCH AND APRIL 1984.

GLOUCESTER HARBOR
MASSACHUSETTS
MAIN SHIP CHANNEL
INNER HARBOR
EXISTING CONDITIONS

PLATE B-3

GLOUCESTER HARBOR
GLOUCESTER, MASSACHUSETTS

NAVIGATION IMPROVEMENT STUDY

RECONNAISSANCE REPORT

APPENDIX C

ECONOMIC EVALUATION

PREPARED BY:

Economic and Resource Analysis Branch
Evaluation Division
Planning Directorate

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

Gloucester Harbor
Gloucester, Massachusetts
Section 107 Reconnaissance Study
Economic Analysis

Introduction

The purpose of this economic analysis is to identify and evaluate the economic benefits of deepening the existing federal channel in Gloucester Harbor in Gloucester, Massachusetts. Gloucester Harbor is located on the northern shore of Massachusetts, about 25 miles north of Boston, on the southern side of Cape Ann. Gloucester is one of the major fishing ports in the United States, consistently ranking in the top 20 ports in the country in terms of both quantity and value of fish landed. In addition, Gloucester is a major fish processing center, with numerous businesses which produce processed frozen fish products.

Methodology

This analysis estimates the National Economic Development (NED) benefits of deepening Gloucester Harbor. NED benefits are defined in Corps of Engineers guidelines as increases in the net value of the national output of goods and services. According to current Corps regulations, only NED benefits can be counted against the costs of a proposed project in evaluating the economic feasibility of the project. For this analysis, which is a commercial navigation analysis, the main NED benefit category is that of transportation cost savings. In this analysis, the current users of the port and their usage patterns are described, the problems with depth they are experiencing are described, and the potential for achieving transportation cost savings with deepening the existing channels is analyzed.

Once the NED benefits are estimated, this analysis will determine whether the proposed improvement plan is economically feasible. A proposed Corps of Engineers improvement plan is considered economically feasible if the NED benefits of the plan equal or exceed the costs of the plan. In accordance with Corps guidelines, benefits and costs are compared in annual terms. Benefits and costs are converted to annual terms using the fiscal year 1995 federal interest rate for water resources projects of 7 3/4 percent and a period of analysis of 50 years. This analysis is performed at the reconnaissance level of detail.

Description of Study Area

The study area consists of Gloucester Harbor and the surrounding port facilities. Gloucester Harbor contains an extensive federal project, which includes the main, 20 foot channel into the north and south channels, an 18 foot channel into Harbor Cove, a 16 foot channel into Smith cove, and two

anchorage areas. The harbor is a major commercial fishing port, as well as a major fish processing center. In addition, the harbor is popular for recreational boaters. A significant amount of freight traffic comes into Gloucester, the majority of which is fish and fish products, although other freight categories of some significance include fuel oil and frozen fruit juice. The harborside facilities include extensive freezer capacity, which facilitate the frozen fish processing businesses, but also allow storage and freight traffic of a variety of frozen food goods. The harborside facilities have a capacity of approximately 80 million pounds of freezer storage. Table 1 shows recent fresh fish landings at Gloucester by quantity and value. Table 2 shows freight traffic through Gloucester in the most significant categories, for the most recent years for which published data is available.

Economic Setting

According to the 1990 US Census, in 1990 the city of Gloucester had a year-round population of 28,716, and contained 13,125 housing units. Gloucester is a small city, and has the varied economic infrastructure required to support any small city, but the economy of Gloucester is most uniquely characterized by its large commercial fishing, fish processing, and freight handling and storage sectors. Gloucester is well located with regards to the highway network of New England, as it is located immediately adjacent to the northern end of Route 128, a major highway which connects to Interstate Highways 95, 93, and 90.

Major Port Users

The major categories of users of the port of Gloucester include commercial fishing vessels, recreational vessels in the summer months, and cargo ships, which are primarily refrigerated cargo vessels and bulk carriers but also include some containerships. Additional but less frequent users include large Russian refrigerated storage ships, which anchor just outside of the harbor and buy fish from the Gloucester fishing vessels, and large cruise ships, which visit Gloucester infrequently, but which the city of Gloucester would like to see visit more often.

Problems with Depth in the Harbor

The existing federal channel in Gloucester Harbor, with its 20 foot depth, provides sufficient depth for the commercial fishing vessels, the recreational vessels, and the smaller cargo ships which use Gloucester Harbor. However, the 20 foot depth is not sufficient for the larger cargo ships which use the harbor or for most cruise ships. In general, any ship with a draft greater than 19 feet will have problems entering or leaving the harbor. The problems caused by the lack of sufficient depth include tidal delays, re-routing of ships, and shipping or cruise ship lines simply not being able to consider Gloucester as a potential port of entry. The large Russian

Table 1
Commercial Fish Landings
Port of Gloucester
Gloucester, Massachusetts

Year	Quantity (Million Pounds)	Value (Million Dollars)
1992	101.7	34.1
1991	107.2	40.0
1990	126.2	40.5
1989	98.5	30.0
1988	107.4	30.8
1987	93.0	34.0
1986	110.0	37.8
1985	116.5	37.1
1984	179.1	37.1
1983	150.9	38.0
1982	146.6	43.6
1981	166.9	45.1
1980	210.0	34.7

Table 2
Freight Traffic
Port of Gloucester
Gloucester, Massachusetts
(short tons)

Year	Total Commerce	Fish and Shellfish	Prepared Fish	Fuel Oil	Fruit and Veg. Juice
1989	105,599	94,356	87	5,946	3,050
1988	175,422	115,097	4,196	43,549	7,853
1987	237,227	200,296	10,783	8,188	12,874
1986	163,664	146,114	6,362	5,767	2,420
1985	172,038	152,427	5,096	9,525	6
1984	99,225	83,804	4,981	7,952	175
1983	174,991	160,740	6,046	10,087	311
1982	135,855	113,907	2,916	12,374	12
1981	163,653	145,777	2,994	9,930	330
1980	212,707	186,065	3,530	11,193	5

refrigerated storage ships which anchor outside the harbor, while too large to use the harbor, do not need to get in the harbor, and so the 20 foot depth does not hinder their operations.

Benefits to Channel Deepening - General

Deepening the federal channel in Gloucester would be a navigation improvement that falls under the benefit regulations contained in the Corps of Engineers Principles and Guidelines, ER 1105-2-100, Section VII, "NED Benefit Evaluation Procedures: Transportation - Deep Draft Navigation". The basis for the calculation of National Economic Development (NED) benefits for large navigation project is contained in paragraph 6.75 of those regulations. "The basic economic benefits from navigation management and development plans are the reduction in the value of resources required to transport commodities and the increase in the value of output for goods and services. Specific transportation savings may result from the use of larger vessels, more efficient use of large vessels, more efficient use of existing vessels, reductions in transit time, lower cargo handling and tug assistance costs, reduced interest and storage costs such as from an extended navigation season, and the use of water transportation rather than an alternative land mode."

In simpler terms, the primary benefit category for federal navigation projects is transportation cost savings. Based on information obtained from the shippers which ship regularly to Gloucester, which is detailed in the sections below, it was determined that the main transportation cost savings which would accrue to a deeper federal channel in Gloucester would be the more efficient use of existing vessels and reductions in transit time. The sections below detail the specific data collected and calculations made in order to estimate the transportation cost savings that would be attained by deepening Gloucester Harbor.

In addition to the transportation cost savings benefits that would be attained from deepening the harbor, which are the NED benefits, there would likely be significant additional benefits that would be realized in the economy of Gloucester and the surrounding area. With a deeper channel in the harbor, shipments to Gloucester could be increased, and this would increase the business of the local stevedoring companies and freight storage companies. If the channel were deeper, cruise ships could also visit the harbor with scheduled regularity, and this would provide an influx of spending into Gloucester, as tourists visited local stores and restaurants, and would also increase stevedoring business. Local interests in Gloucester have a strong interest in promoting containership traffic in Gloucester, which a deeper harbor would facilitate. If Gloucester could be established as a significant containership port, with its easy access to Route 128 and the interstate highway system, this would greatly increase business in Gloucester, and would likely provide very large direct and indirect benefits to

the economy of Gloucester and the surrounding area.

However, these direct and indirect benefits would most likely all fall into the category of "Regional Economic Development Benefits", or RED benefits, as opposed to National Economic Development, or NED, benefits. If traffic increases in Gloucester Harbor as a result of deepening the channel, and local businesses experience increases in business and revenues, and these increases in business cause multiplier effects in the area's economy, these effects would clearly be large benefits to Gloucester and the region. However, since the Corps of Engineers is a federal agency, Corps guidelines require that the Corps analysis be conducted from the national perspective. The increased traffic in Gloucester, and the resulting benefits to the area's economy, would most likely be transfers from another port and region. Gloucester's benefit would most likely be the other port's loss. From the national perspective, the two effects would cancel each other out. As a result, increases in regional business and income are viewed, for Corps analyses, as RED benefits, not NED benefits, and are not able to be counted as benefits toward project justification. Instead, Corps of Engineers guidelines require the analysis of the likely transportation cost savings that would be achieved with the project as the most common NED benefit category for project justification.

In theory, the transportation cost savings achieved with the Corps project would lower the production cost of the products being shipped, and this lower cost, given competition, would ultimately be passed on to consumers in lower product costs. It is this savings that is the NED project benefit, and the value of the transportation cost savings is used as a way of estimating the value of that benefit. Given these requirements for estimating benefits for Corps of Engineers dredging projects, the remainder of this analysis focuses on the transportation cost savings that would be achieved with deepening Gloucester Harbor.

Calculation of Benefits - Detailed

In order to estimate the transportation cost savings that would be achieved with the project, several steps were taken. First, representatives of the two major businesses related to shipping in Gloucester were interviewed, Americold and Elliot Stevedoring. Both located in Gloucester, Americold provides the bulk of the freezer storage around the harbor, and Elliot Stevedoring provides stevedoring services. Based on these interviews, the major shippers using Gloucester Harbor were identified. In addition, a vessel list documenting vessels entering and leaving the harbor over the past four years was provided by local contacts.

There are currently four major shipping lines which either currently ship in and out of Gloucester or have done so in the

recent past: Sunmar Shipping Incorporated, located in Seattle, Washington; Eimskip, located in Iceland but with a US office in Norfolk, Virginia; Samskip, also located in Iceland but which is currently chartering through Eimskip; and SeaTrade, located in the Netherlands. These shippers were contacted and interviewed by telephone. All of the shippers ship primarily frozen fish, with some shipping other frozen food products, such as frozen juices.

All four of the shippers reported some problems with insufficient depth in Gloucester Harbor, particularly for their larger vessels, and all four shippers expressed support for deepening the harbor. For the most part, the problems with depth result in tidal delays. In some cases, the time of arrival is adjusted so that the ship arrives in Gloucester at or near high tide. In these cases, the "delay" is incurred en route, by traveling at a slower speed than necessary. In other cases, the ships wait out the tide outside the harbor, when entering, or docked, when leaving the harbor. These tidal delays cause increased operating costs, costs that would not be incurred if the harbor were deeper. One shipper reported a few incidents of having to reroute a vessel because the vessel was too deep to access the harbor even at high tide. In these cases, the ship, with a normal shipping route from Newfoundland to Gloucester to Boston to New York City, skipped Gloucester and went directly to Boston, unloaded cargo to lighten the vessel, went back to Gloucester, then proceeded on to New York. This caused additional transit time and expense, which could have been prevented if the harbor were deeper.

The shippers were questioned as to whether they would achieve any other efficiencies of operations if Gloucester Harbor were deeper, such as making fewer trips with larger vessels, or in any other way increasing their operating efficiency. None of the shippers reported that they would change their operations in this or any other way if Gloucester Harbor were deeper. The shippers were questioned as to whether, in the future, they would move to larger vessels for other reasons, larger vessels which might have greater problems in using Gloucester Harbor. Several of the shippers reported they might use larger vessels in the future, but could not report with confidence the likely size of the future vessels, nor were they anticipating any specific new problems. Overall, all of the shippers indicated that deepening Gloucester Harbor would improve the port and make their operations more convenient and more flexible. In addition, several of the shippers noted the positive economic effects for Gloucester that would likely result from port expansion. However, other than the tidal delays and some rerouting incidents, no other major benefit categories were identified by the shippers.

Based on the interviews with the shippers and based on the information provided by the local contacts, it was determined that there were two primary benefit categories to deepening

Gloucester Harbor. These two benefits categories are tidal delay costs prevented, and rerouting costs prevented. The dollar value of these benefits was estimated using information provided by the shippers and by the local Gloucester contacts, and using the boat list of arrivals and departures over the last four years. The calculation of these benefit figures are detailed in the two sections below. As required by Corps guidelines, the benefits are calculated in annual terms.

Tidal Delay Costs Prevented

Based on a variety of data collected from the different sources contacted, it was determined that the likely annual value for the tidal delay costs that would be prevented with deepening Gloucester Harbor falls in the range between $64,410 and $154,000 per year. Based on the vessel list provided by local contacts which shows the draft of vessels arriving and departing Gloucester Harbor over the past four years, and assuming that any vessel with a draft greater that 19 feet would have a tidal delay, it was determined that the average number of vessels on a yearly basis that would have tidal delays is 22. Of the total estimated 22 tidal delay incidents, it is estimated that 70 percent, or 15, would be delays coming in to Gloucester, and 30 percent, or 7, would be delays leaving Gloucester. There are fewer delays attempting to leave Gloucester since a ship will usually have a deeper draft when arriving Gloucester loaded, and then will have a shallower draft after the cargo has been unloaded and the ship then attempts to leave.

Current Corps of Engineers guidelines provide cost tables to be used for the hourly value of operating costs of different types and sizes of vessels. Based on those tables, the operating cost of the larger types of vessels which use Gloucester Harbor and experience tidal delays is estimated at $515 per hour while at sea and $430 per hour in port. Based on information provided by local contacts, the average tidal delay is estimated to be 6 hours. This yields total annual tidal delay costs of $64,410, as shown below:

Delay costs at sea:
15 incidents/yr X 6 hrs X $515/hr = $46,350
Delay costs in port:
7 incidents/yr X 6 hrs X $430/hr = $18,060
Total annual tidal delay costs:
$46,350 + $18,060 = $64,410

A second way of estimating the total annual tidal delay costs was also used. Local contacts provided an estimate that the tidal delays cost an average of $7,000 per incident. Assuming an average of 22 incidents per year, this yields an annual value of $154,000 for tidal delay costs (22 incidents/yr X $7,000/incident = $154,000/yr).

Given the two different ways of calculating the cost of the tidal delays, these two values are used as the likely upper and lower bounds for the annual cost of the tidal delays currently being experienced. Without a federal dredging project, these delays will continue to occur. With a federal dredging project, these delays would be prevented, and thus the value of the delays prevented would be benefits to the dredging project.

Rerouting Costs Prevented

Based on information obtained in the interviews with the shippers, it is estimated that there is an average of 2 incidents a year when a vessel must bypass Gloucester for Boston, unload in Boston, travel back up to Gloucester, then continue on to New York. Based on information provided by local contacts, this adds an additional 9 hours of travel time to the total trip, 3 hours from Gloucester to Boston, 3 hours back up to Gloucester, and 3 hours back down to Boston. Using the Corps of Engineers cost tables, as were used for the tidal delay benefits, the average hourly operating costs at sea for the type and size of vessel being rerouted is estimated at $515 per hour. This yields a total annual rerouting cost of $9,270 (2 incidents/yr X 9 hrs/incident X $515/hr = $9,270/yr).

Without a federal dredging project, these rerouting incidents will continue to occur. With a federal dredging project, they would be prevented, and thus the value of the rerouting incidents prevented would be benefits to the dredging project.

Other Benefit Categories

Local interests described several additional potential benefits which could occur if Gloucester Harbor were deepened. These benefits, and the reasons they were not examined further in this report, are addressed in this section.

Local interests, including harborside businesses as well as the City of Gloucester, have been working toward developing Gloucester as a containership port. While Gloucester does receive a small amount of containership traffic now, local interests would like to greatly increase the amount of containership traffic, which would greatly stimulate the economy of the area. Increasing the amount of containership traffic would be facilitated by deepening the channels in the harbor, although, given the complexity of shipping patterns and the goods' movements and markets, deepening the channels would not be the only factor required to increase containership traffic at Gloucester. The majority of the benefits which would likely accrue if containership traffic increased at Gloucester would fall into the category of Regional Economic Development (RED) benefits, not National Economic Development (NED) benefits and, as described previously in this report, RED benefits cannot be counted towards justification of a Corps of Engineers project.

While the majority of the benefits from increasing containership traffic in Gloucester would be RED benefits, there could theoretically be some NED benefits, if it could be proven that there would be specific efficiencies for specific goods by shipping them to Gloucester instead of to wherever they are currently being shipped. However, it would be extremely difficult at this point to determine the value of any such savings since this traffic is potential future traffic that is not occurring now, and, as a result, these benefits would be very speculative in nature. Obtaining sufficient information from shippers to document the likely future containership traffic in Gloucester, and then determining whether there are any transportation cost savings involved, would be extremely difficult. Given the difficulties involved, and given the speculative nature of any such benefits, these potential benefits were not analyzed further for this reconnaissance-level study.

A related benefit cited by local interests is the potential increase in cruise ship traffic that could occur if Gloucester Harbor were deeper. As with the increase in containership traffic, the majority of these benefits would be primarily RED benefits, and, while there could be a small amount of NED benefits, these benefits would be very speculative and difficult to document at this time. For these reasons, the benefits related to a future increase in cruise ship traffic in Gloucester were not analyzed further for this study.

The final benefit category which could exist is the potential for loss of traffic at Gloucester if recent trends toward larger vessels continues. All of the shippers interviewed were questioned for any information they could provide that would support benefits being claimed under this category. Based on the results of the interviews, there was little evidence to support benefits in this category. Only one of the shippers had definite plans to move to larger vessels in the near future, and did not anticipate decreasing their shipments to Gloucester based on this change. Based on the interviews with the shippers, there was insufficient evidence to warrant the inclusion of benefits under this category.

Benefit Summary

The two categories of transportation cost savings claimed as the benefits for the proposed deepening of Gloucester Harbor are tidal delay costs prevented and rerouting costs prevented. For the purpose of examining potential project justification, both the upper and lower bound figures are used. The benefits are summarized in Table 3, below.

Table 3
Benefit Summary

Benefit Category	Annual Benefit
Tidal Delay Costs Prevented	
Upper Bound Value	$154,000
Mean Value	$109,200
Lower Bound Value (Say)	$ 64,400
Rerouting Costs Prevented (Say)	$ 9,300
TOTAL ANNUAL BENEFITS	
Upper Bound Value	$163,300
Mean Value	$118,500
Lower Bound Value	$ 73,700

Economic Justification

In order for a proposed project to be considered economically justified, it must have a benefit to cost ratio equal to 1.0 or greater. The total annual benefits, total annual costs, benefit to cost ratio, and net annual benefits of the proposed dredging project are shown in Table 4, below. As a sensitivity analysis, the benefit to cost ratio is calculated using the upper bound and lower bound benefit values.

Table 4
Economic Justification

	Annual Benefits	Annual Costs	Benefit to Cost Ratio	Net Annual Benefits
Upper Bound Benefit Value	$163,300	$270,400	0.60	None
Mean Value	$118,500	$270,400	0.44	None
Lower Bound Benefit Value	$ 73,700	$270,400	0.27	None

GLOUCESTER HARBOR
GLOUCESTER, MASSACHUSETTS

NAVIGATION IMPROVEMENT STUDY

RECONNAISSANCE REPORT

APPENDIX D

TOPOGRAPHY, GEOLOGY AND OCCURRENCE OF BEDROCK IN THE CHANNEL

PREPARED BY:

Geology and Chemistry Branch
Geotechnical Engineering Division
Engineering Directorate

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

APPENDIX D

GLOUCESTER HARBOR - SECTION 107 RECONNAISSANCE STUDY TOPOGRAPHY, GEOLOGY, AND OCCURRENCE OF BEDROCK IN THE CHANNEL

1. BACKGROUND.

The present study considers modifying Gloucester Harbor to allow the passage of larger vessels; specifically, deepening the existing channel and turning basin from -20 feet MLW to either -24 or -26 feet Mean Low Water (MLW). The overdredge depths for these two alternatives would be -27 and -29 feet, respectively, where bedrock occurs at or above the project depth. The thickness of bottom materials to be removed ranges from 0 feet in portions of the outer harbor, to 3 to 6 feet in most of the main and north channels, and up to 10 feet in shoaled areas and in areas where bedrock is shallow.

Previous studies and historical accounts of navigation in Gloucester Harbor have documented bedrock occurring within the proposed project depths. Given the far greater effort and cost associated with bedrock ("ledge") removal, the delineation of bedrock above the project overdredge depth is a vital element in the project design.

This appendix provides the geologic setting of the study area, describes the subsurface materials, and details the bases for bedrock contouring. The geologic conditions presented herein are based on historical information and subsurface data obtained from Congressional Records and other Corps historical documents. No subsurface explorations or geophysical investigations were conducted.

2. TOPOGRAPHY.

Gloucester Harbor is located on the rocky coast along the southeast flank of Cape Ann. The harbor is aligned northeast-southwest, roughly paralleling the underlying structure of the Coastal Lowlands physiographic region, the broad northeast-trending belt extending from the Rhode Island coast north to Augusta, Maine (Denny, 1982). While areas of the Lowlands attain elevations of up to 360 feet above mean sea level regionally, maximum elevations in the study area range from 100 to 150 feet above mean sea level. The land area surrounding the harbor is hilly, with numerous bedrock exposures, as the surface topography is essentially the expression of the underlying bedrock surface.

Topography of the harbor and channel bottoms is that of a submergent river channel, with some irregular peaks, pinnacles, and mounds of more resistant bedrock protruding above the surrounding seafloor. Early Congressional Records reported numerous submerged points of ledge and boulders and extensive areas of ledge at approximately -15 MLW (see Plate D-1). Despite the numerous occurrences of shallow bedrock, large portions of the harbor were reported to have natural water depths (prior to dredging) of 20 feet or more.

3. GEOLOGY.

3.1 General. The geology of New England is the result of a complicated history of mountain building, intrusion, and metamorphism. The area has been glaciated several times and the modern landscape is largely one of remnant surficial deposits of glacial origin overlying crystalline bedrock. The retreat of the glaciers brought about a rise in sea level, accompanied by the tectonic rebound of the land as it was unloaded. This trend appears to have stabilized, and now the New England region appears to be subsiding very slowly. Sea level continues to rise very slowly.

3.2 Bedrock Geology. Almost all of Cape Ann is underlain by igneous rocks of the Cape Ann intrusive complex which were emplaced during the Paleozoic era (Barosh, P. J., Fahey, R. J., and Pease, M. H. Jr., 1977). Gloucester Harbor is underlain primarily by the Cape Ann Granite. Generally, this granite is described as medium to coarse grained and unfoliated. Bedrock was cored in three locations in the main channel and north channel as part of the 1964 Corps of Engineers investigations for design of the existing 20-foot project. The granite encountered in these borings was gray to light pinkish gray, medium grained, and had frequent high angle fractures. Below the fractured, iron-stained zone in the uppermost 10 to 15 feet, the rock was hard, sound, and largely unweathered.

3.3 Surficial Geology. Sediments overlying the bedrock in the harbor consist of alluvial/marine deposits (clay, silt, sand, gravel) of varying thickness, underlain in some areas by variable glacial deposits (till and stratified drift).

4. OCCURRENCE OF LEDGE IN GLOUCESTER HARBOR.

4.1 Previous Dredging and Ledge Removal. Since the late 1800s, there have been numerous projects, both federal and state, to improve Gloucester Harbor by deepening the navigation channel and removing rock obstructions. The -15 MLW project was authorized in 1888, and completed in 1894, with removal of additional pinnacle rocks in the inner and outer harbors occurring between 1896 and 1916. The City of

Gloucester and the Commonwealth of Massachusetts also dredged portions of the harbor between 1952 and 1960. In 1964, the Corps of Engineers issued plans and specifications for improvement dredging and rock removal, resulting in the existing -20 MLW project.

4.2 Previously Identified Ledge Areas. The 1908 Congressional Report first identified historical ledge areas A, B, and C in the inner harbor, and ledge areas D, E, F, G, H, and I in the outer harbor, giving the maximum elevation and approximate volume of each ledge area, as shown in Plate D-1.

Historical ledge areas A and B correspond with ledge areas A and B of this appendix, as shown in Plate D-2. Historical ledge areas C and D are located outside the proposed channel alignment, near Harbor Cove and Western Harbor. Historical ledge areas E through I are located in the outer harbor, and are also located outside the proposed channel extension.

The 1932 Congesssional Report included probe data from an investigation in historical ledge areas A, B, and C for designing a dredging and rock removal project to -18 MLW. Approximately 1,650 cubic yards of ledge removal were estimated for this project. Deepening of the channel to -18 MLW was ultimately found to be not justified, and the proposed federal project was not executed.

Corps historical records contain the results of probe investigations conducted during the study (1959) and design (1964) of the existing -20 MLW project. In the 1964 project plans and specifications, 1,000 cubic yards of ledge and 154,000 cubic yards of unclassified materials were estimated for removal.

4.3 Present Study.

Bedrock was contoured for the present study on the basis of the previous probe and boring data from 1932, 1959, and 1964. The 1932 probes were concentrated along the North Channel and the entrance to Harbor Cove, and typically extended only to elevations of -20 to -23 MLW. The 1959 probes were also concentrated in the North Channel, and typically extended to elevations of -23 to -25 MLW, except where refusal was encountered at shallower depths. The 1964 probes were concentrated in several isolated areas throughout the entire Gloucester inner harbor, North and South Channels and Harbor Cove. Many of these areas lie outside the present study area, but the historic ledge areas A and B, and an area along the western edge of the entrance channel were probed. In addition, ten borings were done in the vicinity of ledge

areas A and B, and in the entrance channel. Most of these probes and borings extended only to elevation -24 MLW.

For this appendix, ledge areas A, B, C, D, and E are identified (see Plate 2). Ledge areas A and B have the most historical data associated with them.

4.3.1 Ledge Area A. Ledge area A was contoured as a single elliptical mound, using a combination of data, including the following:

a. The delineation of "Ledge Area A" in the 1908 and 1932 Congressional Records.
b. Three probes from the 1959 investigation encountered shallow refusal in this area (P-11, P-12, and P-13).
c. One boring from the 1964 program (FD-7) encountered granite bedrock at elevation -17.4 MLW.
d. Approximately 120 probes were made in this area, on a 20-foot grid pattern, as part of the 1964 program, with most extending to -24 MLW. Some of these probes encountered shallow refusal (-18 to -20 MLW). The 1964 plans and specifications called for removal to -21 MLW, with an allowable overdredge depth of -22 MLW.

4.3.2 Ledge Area B. Ledge area B was contoured as three separate mounds and two single pinnacles, using a combination of data, as detailed below:

a. The delineation of "Ledge Area B" in the 1908 and 1932 Congressional Records.
b. The single pinnacle located at the farthest point upstream in the channel is predicted on the basis of one probe from the 1932 program (P-24) which encountered shallow refusal (-18.9 MLW).
c. The single pinnacle located farthest downstream in the channel is predicted on the basis of one probe from the 1959 program (P-44) which encountered shallow refusal (-14.8 MLW).
d. The three mounds are contoured primarily on the basis of shallow refusals encountered in the 1959 and 1964 probes. A total of approximately 90 probes were made in this area.
e. Two borings from the 1964 program (FD-6 and FD-18), located just northwest of the historical Ledge Area B, extended to -27 and -32 MLW and terminated in till, without encountering bedrock.

Since ledge area B is defined primarily on the basis of probe data, without confirmation from borings, it is not certain whether the features contoured are bedrock or dense glacial till. Given the historical delineation of this area as ledge, however, bedrock has been assumed for estimating purposes.

4.3.3 Ledge Area C. Ledge area C, located off Rocky Neck along the east side of the entrance channel, is identified somewhat speculatively, based on bottom topography, with no confirmatory subsurface data. Given the nearby bedrock exposures at Rocky Neck, however, it is assumed for estimating purposes that this feature is bedrock.

4.3.4 Ledge Area D. Ledge area D, located near the center of the entrance channel, corresponds to area 9A from the 1964 program. This area is contoured on the basis of one boring (FD-21) which encountered granite bedrock at -17.5 MLW, and two other probes which had shallow refusals. A total of 30 probes were made in this area, on a 20-foot grid, extending to -28 MLW. The 1964 plans and specifications called for removal to -24 MLW, with an allowable overdredge depth of -25 MLW.

4.3.5 Ledge Area E. Ledge area E, located off Ten Pound Island in the outer harbor, consists of two pinnacles (-20.9 and -21.7 MLW) which were detected in the 1994 condition survey. These pinnacles are most likely bedrock, given their proximity to the "rocky" points noted (-19 and -18 MLW) on the 1992 NOAA charts. The records were not found to show when ledge was removed from this area. These pinnacles likely represent incompletely removed bedrock from past work in this area.

5. SUMMARY

In summary, bedrock has been contoured where it is suspected to exist above elevation -29 MLW, based on the information available and best judgement. The bedrock surface is likely to be irregular, and not as smooth as depicted by the contours. Some of the ledge areas identified and contoured may prove to be somewhat larger or smaller than estimated, and shaped differently than shown. Based on the historical data and information available, however, it is felt that the major areas of ledge have been identified.

The historical probe data for Gloucester Harbor has some limitations, in that most of the probes extend no deeper than -24 MLW, and are concentrated in the main areas of known/suspected ledge. While isolated rock pinnacles may exist in some portions of the harbor for which data are limited, the quantity of rock in these isolated pinnacles will not significantly impact the overall quantities estimated for the project.

Feasibility study efforts for the design of a dredging and rock removal project in Gloucester Harbor should include a comprehensive file search, and subsurface explorations (probes and borings). The information included in this appendix

provides a starting point for future investigations. Borings should be made to confirm the nature and extent of subsurface materials in Ledge Areas B, C, and E. The limits of Ledge Areas A and D should be more precisely defined with additional subsurface investigations (borings and/or probes). Geophysical investigations are probably not cost-effective and would not be recommended for this site, as it would be difficult to differentiate between dense till deposits and bedrock using this technology.

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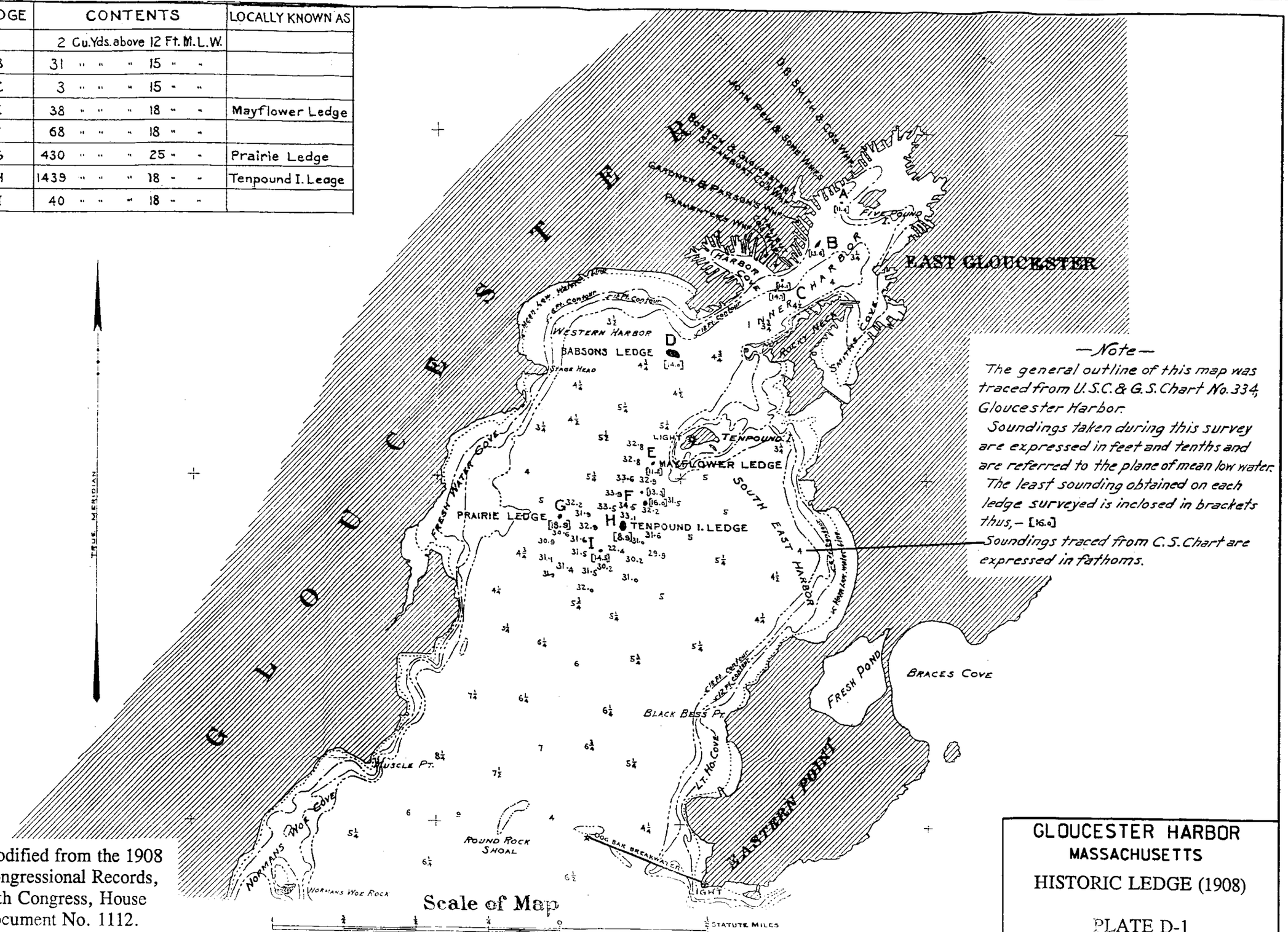
LEDGE	CONTENTS	LOCALLY KNOWN AS
A	2 Cu.Yds. above 12 Ft. M.L.W.	
B	31 " " " 15 " "	
C	3 " " " 15 " "	
E	38 " " " 18 " "	Mayflower Ledge
F	68 " " " 18 " "	
G	430 " " " 25 " "	Prairie Ledge
H	1439 " " " 18 " "	Tenpound I. Leage
I	40 " " " 18 " "	



—Note—

The general outline of this map was traced from U.S.C.& G.S. Chart No. 334, Gloucester Harbor.

Soundings taken during this survey are expressed in feet and tenths and are referred to the plane of mean low water.

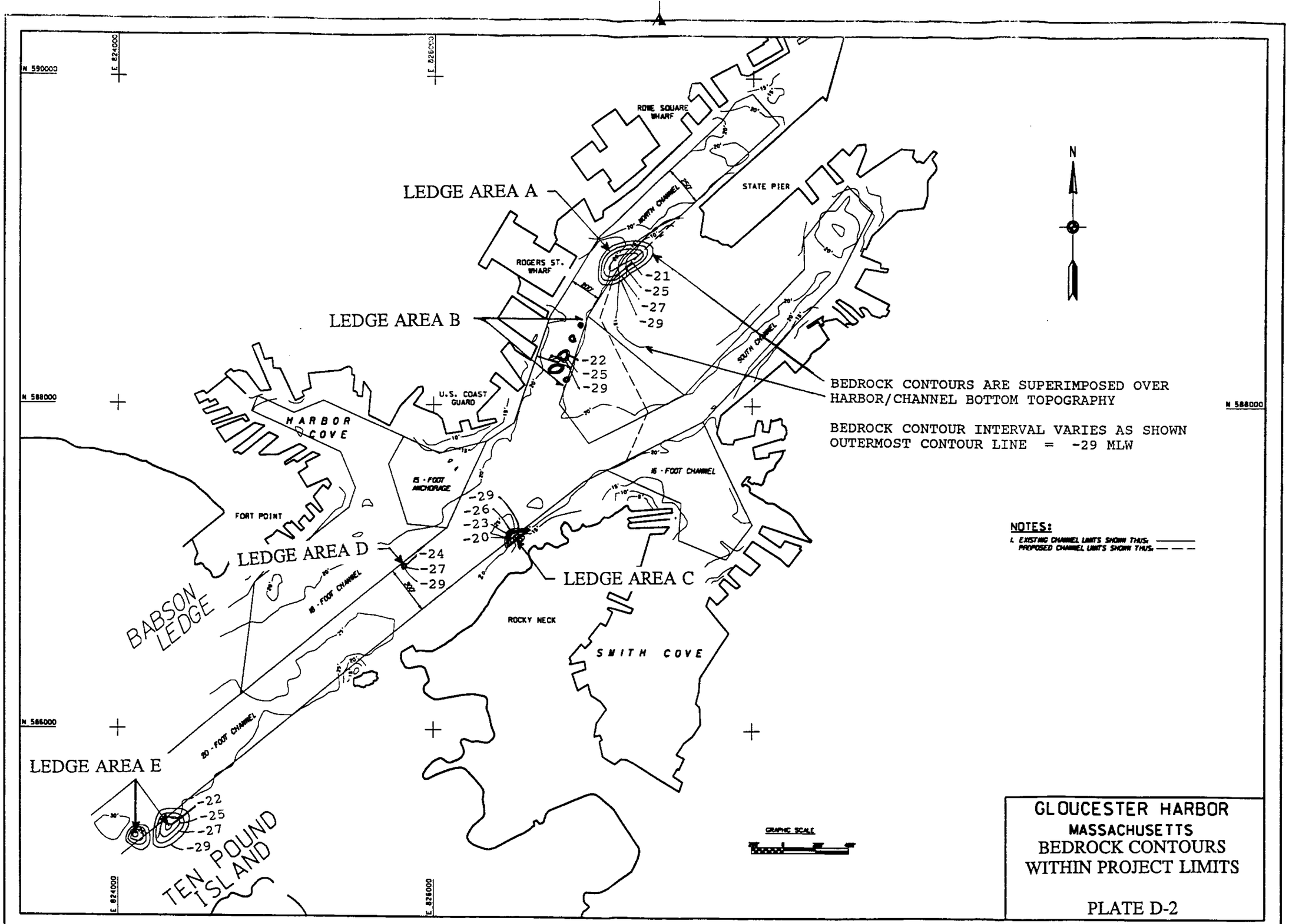
The least sounding obtained on each ledge surveyed is inclosed in brackets thus,— [16.0]

Soundings traced from C.S. Chart are expressed in fathoms.

Modified from the 1908 Congressional Records, 60th Congress, House Document No. 1112.

GLOUCESTER HARBOR
MASSACHUSETTS
HISTORIC LEDGE (1908)

PLATE D-1



GLOUCESTER HARBOR
MASSACHUSETTS
BEDROCK CONTOURS WITHIN PROJECT LIMITS

PLATE D-2

GLOUCESTER HARBOR
GLOUCESTER, MASSACHUSETTS

NAVIGATION IMPROVEMENT STUDY

RECONNAISSANCE REPORT

APPENDIX E

PROJECT HISTORY

PREPARED BY:

Project Planning Branch
Formulation Division
Planning Directorate

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

GLOUCESTER HARBOR, MASSACHUSETTS
PROJECT HISTORY

The River and Harbor Act of 11 July 1870 called for a survey of Gloucester Harbor. A Survey Report, dated 20 January 1871, printed in House Ex. Document #60, 41st Congress, 3d Session, reported on proposed improvements to Gloucester Harbor (Annual Report (AR) for 1871, App. V-19, Page 869). The report provided estimates for the removal of several ledges and rock pinnacles in the Inner Harbor, including: Babson's Ledge to -18 Feet MLW (670 cy), Clam Rock at the entrance to Harbor Cove to -9 feet MLW (30 cy), Pinnacle Rock (79 cy), Rock off Friend's Wharf to -17 feet MLW (22 cy), and a rock off Pew's Wharf to -5 feet MLW (3 cy). With the exception of Babson's ledge, each of these features were to be reduced in elevation to the level of the surrounding bottom. The Survey Report also examined the proposal to construct a breakwater extending about 3,870 feet westerly from Eastern Point Across Dog bar to Round Rock Shoal following the natural crest of the submerged ridge. The breakwater was to be of rubble stone quarried on Eastern Point and built up to MHW elevation with a top width of 20 feet and slopes as formed by nature, with a stepped superstructure consisting of two walls of fitted stone filled in between with concrete and capped with stone, with a top elevation of +11 feet MHW with a top width of 10 feet (total of 257,356 tons of substructure rip-rap, 65,415 tons of fitted granite and 8,373 cy of concrete fill estimated). The plan from this survey is shown in Figure E-1. The River and Harbor Act of 10 June 1872 authorized the removal of the ledges and rock pinnacles from Babsons Ledge and the Inner Harbor, but did not act on the breakwater recommendation (AR 1872, App. V-16, Pg. 941). Work on the ledge removal was begun in November 1872, beginning at Babson's Ledge and was completed in June 1873 with Clam Rock removed to -9.3 feet, Pinnacle Rock removed to -16.5 feet, the rocks off Friend's Wharf to removed to the surrounding bottom level at -17 feet MLW, and Pew's Wharf Rock was removed to -5 feet MLW (AR 1873, App. X-18, Pg. 48). Removal of boulders and rock from atop Babsons Ledge was only carried to a depth of -14 feet MLW by removal of about 350 cy of rock, though the later survey of 1884-85 showed there still remained boulders protruding above the -14-foot elevation.

The River and Harbor Act of 5 July 1884 called for an examination of Gloucester Harbor with a view towards removal of three ledge pinnacles in Harbor Cove to an elevation below the surrounding bottom. A Preliminary Examination, dated 27 September 1884, found the area worthy of improvement and a subsequent examination and estimate, dated January 20, 1885, recommended the removal of Babson's Ledge to a depth of -21 feet MLW and further surveys of the other ledges under consideration, including those in the Inner Harbor and Muscle Point Reef on the western side of the entrance to the Outer Harbor. (Both reports were published in House Ex. Doc. #169, 48th Congress, 2d Session, and may also be found in the Annual Report for 1885, Page 540).

The River and Harbor Act of 5 July 1884 also called for an examination of potential harbors of refuge at Cape Ann including Gloucester Harbor. A project submitted 19 November 1884 (Annual Report for 1885, Page 534) called for construction of two rubblemound breakwaters across the harbor's mouth. The first breakwater would extend about 4,000 Linear Feet (LF) northwesterly from Eastern Point to Round Rock Shoal, in a more direct straighter alignment than that proposed in 1871, and the second extending about 3,250 LF easterly from the west shore across Norman's Woe rock and beyond to deep water. Both structures were designed for slopes of 1:1 leeward and 1:2 seaward, with rubblemound sections up to the MLW elevation surmounted by fitted rock superstructures filled with concrete, and with a top elevation of +8 feet MHW.

The further removal of Babson's Ledge was authorized by the River and Harbor Act of 5 August 1886. The 1884-85 survey found that Babsons Ledge was more extensive than had been earlier believed and that additional rock required removal merely to bring the elevation down to the -14-foot MLW elevation though secured by the 1872-73 operations. The appropriation from the 1886 Act was used in removing rock to secure the uniform -14-foot MLW depth over the ledge (AR 1887, App. B-5, Pg. 503). This work was completed in 1888.

A Preliminary Survey Report, dated 28 February 1887, published in the Annual Report for 1887, Page 505, was prepared in response to the River and Harbor Act of 5 August 1886, and was favorable to completion of a full survey. The map from this survey is shown in Figure E-2. As a result of that survey, the Annual Report recommended: 1) the adoption of the Dog Bar Breakwater project as submitted in November 1884, 2) the establishment of a -15-foot MLW channel extending about 3,900 LF from Babsons Ledge along the northern waterfront of the Inner Harbor through dredging and the removal of ledges between Harbor Cove and Pews Wharf, 3) reducing the planned depth of removal at Babson's Ledge to -14 feet MLW, and 4) the dredging of Harbor Cove to a depth of -10 feet MLW. (Total Est. for items #2 & #4 - 216,000 cy ordinary and 102 cy rock). The locations of these works are shown in Figure E-3, from the AR of 1887. This work, except for the breakwater, was authorized by the River and Harbor Act of 11 August 1888. As described above, the removal of Babsons Ledge to -14 feet was completed in 1888.

The dredging of Harbor Cove to -10 feet was accomplished in three stages. First, during the period of fiscal years 1888 and 1889, two 40-foot wide channels along the eastern (550 LF) and western (1,000 LF) waterfronts of Harbor Cove to -10 feet MLW were dredged and some ledge was also removed from the north side of the Inner harbor itself (Total 170 cy rock and 17,568 cy dredging). This Dredging uncovered some additional small areas of ledge that would also require removal later (AR 1890, App. B-6, Pg. 491). The Act of 19 September 1890 appropriated additional funds to continue the deepening of Harbor Cove (AR 1891, App. B-6, Pg. 635). This second phase of dredging was begun in July 1891 and completed November 1891, with 41,298 cy removed, widening the two -10-foot channels in Harbor Cove to 140 feet wide each and clearing the north waterfront of the Inner Harbor between Fort Point and the Steamboat Wharf to -15 feet MLW, except for additional small ledges uncovered by the dredging (AR 1892, App. B-6, Pg. 566). The final stage of the -10-foot MLW dredging for Harbor Cove and the -15-foot dredging of the northern waterfront area, as contemplated in the authorization of 1888 (150,000 cy estimated), was carried out during July-September 1893 (AR 1893, App. B-7, Pg. 751). This work however, uncovered still more ledge areas which were removed between April 1894 and July 1894 (549 cy rock total) completing the project contemplated in the Act of 1888. (AR 1894, App. B-7, Pg. 541 and AR 1895, App. B-7, Pg. 609).

The River and Harbor Act of 13 July 1892 called for examination of both the Inner Harbor and Vincent Cove, a small cove leading off the northern waterfront of the Inner Harbor. The Preliminary Examination of Vincent Cove, dated 27 October 1892 was published as House Ex. Doc. #56, 52nd Congress, 2d Session, dated 8 December 1892. The report stated that the cove was too small to warrant further government interest for navigation. This area was later filled by local interests. The Preliminary Examination covering the Inner Harbor, also dated 27 October 1892, was published as House Ex. Doc. #70, 52nd Congress, 2d Session, dated 8 December 1892 (Also AR 1893, App-B, Pg. 787). This examination recommended the further removal of a ledge area extending westward from Five-Pound Island into what is presently the north channel and the extension of the proposed dredge area further northeasterly along the north waterfront, but no action was taken on this recommendation at that time.

The River and Harbor Act of 17 August 1894 authorized and appropriated funds to begin construction of the Dog Bar Breakwater. The first contract for construction of the breakwater was begun in November 1894 with 35,497 tons of stone having been place to complete the first 400 LF of the substructure by the close of that Fiscal Year (FY) the following June (AR 1895, App. B-7, Pg. 609). Operations under this contract on the breakwater substructure continued in fiscal years 1896 and 1897 with a additional 17,101 tons placed in FY1896 (AR 1896, App. B-6, Pg. 596) and 4,202 tons placed in July 1896 (FY1897). A second contract for continuing the substructure work began placement of stone in November 1896 and continued through April 1898 with 17,668 tons place in FY1897 (AR 1897, App. B-6, Pg. 835) and 16,332 tons placed in FY1898 for a total of 90,800 tons of stone placed in the substructure up to that time completing 1,650 LF of the substructure.

The River and Harbor Act of 3 June 1896 authorized and appropriated funds for the removal of other ledge pinnacles including Elishas Rock in the Outer Harbor to -16 feet MLW and the removal of rocks located off the ferry landing on Rocky Neck to the elevation of the surrounding bottom. A plan for accomplishing this work was approved by the Chief of Engineers on 5 May 1897 (AR 1897, App. B-6, Pg. 835). This work was begun under contract in July 1897 and was completed in August 1897 with a total of 105 cy of rock removed (AR 1898, App. B-6, Pg. 856).

A proposal to modify the breakwater design was submitted on 18 December 1897 (AR 1898, App. B-6, Pg. 857). This modification called for the rubble-stone substructure to have a top width of 31 feet at the MLW elevation, with slopes of 1/1.3 for the entire leeward face and 1/1.5 seaward up to elevation -12 feet MLW, then 1/3 for the remaining height up to MLW, with a fitted stone block superstructure formed by two walls filled between with rubble-stone and capped with heavy fitted stone at a top elevation of +17 feet MLW with a top width of 10 feet. This modification was approved by the Chief of Engineers on 4 January 1898.

The River and Harbor Act of 3 March 1899 provided additional funds towards completion of the breakwater (AR 1899, App. B-6, Pg. 1066). During FY1900, 15,886 tons of additional stone were placed under contract in the previously built 1,650 LF of substructure to bring this length of the structure to the section width and slopes specified by the modified design. Work also began later that FY on the superstructure with the first 10 tons of fitted stone placed (AR 1900, Pg. 1165). This contract continued during FY1891 until October 1890 with an additional 4,419 tons of fitted stone and 1,421 tons of rubble fill placed in the superstructure. The total amount of stone now placed was 106,686 tons in the substructure and 4,429 tons of fitted stone plus 1,421 tons of rubble stone in the superstructure (AR 1901, App. B-11, Pg. 1049). Some 284 LF of the superstructure was completed at this time, though this would be reduced to 277 LF in the next annual report, presumably due to storm damage.

The River and Harbor Act of 13 June 1902, further modified the design of the breakwater. The Act called for the breakwater to be terminated at Cat Ledge, at a total length of 2,250 LF, short of its original 4,000 LF design length to Round Rock. In lieu of the additional breakwater length, the Act called for the removal of Round Rock and the surrounding shoal (AR 1902, Pg. 88 & App. B-12, Pg. 857). The Act also provided for a continuing appropriation toward completion of the structure. Under this appropriation work was begun under contract in May 1903 (AR 1903, App. B-11, Pg. 744) and continued through September 1906 when the breakwater as called for in the modification of 1902 was completed. The progress of the work during these years is shown below in terms of tons placed. The substructure design was augmented by a rubble stone apron placed atop the seaward toe of the

substructure to arrest settling due to wave damage (AR 1904, App. B-10, Pg. 838). The revised design also included rasing the head of the structure to an elevation of +20 feet MLW to support a navigation light.

		Leveling	Superstructure	
	Substructure	& Apron	Fitted Stone	Rubble Fill
Work prior to FY 1902	106,686	-------	4,429	1,421
FY 1903	-------	-------	2,364	1,734
FY 1904	39,496	8,472	16,237	4,082
FY 1905 (AR 1905, Pg. 808)	4,982	7,702	16,323	5,034
FY 1906 (AR 1906, Pg. 872)	4,657	-------	1,091	6,369
	155,821	16174	40,444	18,640

Total Placed Through End of FY1906 = 231,079 tons

The Annual Report for 1906 and subsequent annual reports carry a figure of 231,756 tons as the total placed in the structure, but as seen above the figures presented in the prior annual reports do not add up to that amount.

The River and Harbor Act of 2 March 1907 called for an examination and survey of Gloucester Harbor with a view to further ledge removal. Both Reports were published in House Doc. #1112, 60th Congress, 2d Session, dated 9 December 1908. The Preliminary Examination, dated 24 October 1907, considered local requests for the removal of ledge areas in both the Inner and Outer Harbors. In the Outer Harbor further removal of Babson's Ledge, and the removal of Round Rock and several ledge areas in the vicinity of Tenpound Ledge was desired. In the Inner Harbor additional removal of ledge areas obstructing access to the wharves was desired. The Survey Report, dated 31 October 1908, concentrated on ledge areas in the Outer Harbor and declined further consideration of ledge removal in the Inner Harbor with the exception of work on three ledge areas along the northern waterfront which were found not to have been removed entirely to grade during prior operations (Ledges A, B & C) and which were recommended for additional work to establish the prior authorized inner harbor depth of -15 feet MLW (36 cy rock total estimate). In the Outer Harbor the further removal of Babson's Ledge was reported as unnecessary and Round Rock was not included in the investigation as it was then being surveyed in connection with the existing authorization. The report considered the removal of Prairie Ledge to the west of the channel to -25 feet MLW (430 cy rock estimate), and the removal of several ledge areas extending southwesterly from Tenpound Island to the vicinity of Tenpound Island Ledge to -18 feet MLW, the level of the surrounding bottom in that area (1,585 cy rock total estimate). The map from this survey report is shown as Figure E-4. This work was authorized by the River and Harbor Act of 25 June 1910 (AR 1910, Pg. 65).

The survey of Round Rock, conducted in the fall of 1908, revealed that it was more extensive in area than previously believed, and that the cost of removing it to grade would be far in excess of the cost of extending the breakwater west from Cat Ledge to Round Rock. The Board of Engineers for Rivers and Harbors therefore recommended a return to the original breakwater authorization of 1884 including extension of the breakwater to Round Rock and elimination of the authorization for removing Round Rock. (AR 1909, Pg. 54). During December of 1908 the first maintenance was performed on the Dog Bar breakwater with the resetting of displaced capstones and a survey of the proposed alignment for the breakwater extension to Round Rock Shoal was also made (AR 1909, App. B-5, Pg. 985).

The River and Harbor Act of 27 February 1911 provided an appropriation to supplement the design of the breakwater through placement of additional rubble stone as an apron along the seaward face of the breakwater at the toe of the superstructure. The work was begun in June of 1911(AR 1911 Pg. 69) and completed in December 1912 with the placement of a total of 17,538 tons of stone (AR 1912, App. B-5, Pg. 1380, and AR 1913, Pg. 69). Further repairs to the breakwater superstructure were also undertaken in 1913 with 85 cap stones being reset and repinned. Drilling and blasting for removal of ledge areas under the 1910 authorization began under contract in May 1912, and removal was completed in December 1916 (2,206 cy rock total). (AR 1917, Pg. 88).

The River and Harbor Act of 25 July 1912 called for a further examination of Gloucester Harbor with a view toward providing a depth of -15 feet MLW in Harbor Cove. A Preliminary Examination, dated 29 November 1912 was prepared in response. This Report is printed in House Doc. #1357, 62nd Congress, 3d Session, dated 6 February 1913. The Commonwealth had previously dredged much of Harbor Cove to the -15-foot MLW depth, but this dredging did not extend to the pierhead line due to the discovery of ledge areas during dredging. The report concluded that further dredging in Harbor Cove along the pierhead line would properly be a non-Federal responsibility due to the cove's local character of use.

A resolution of the House Committee on Rivers and Harbors, adopted 27 February 1929, requested a review of existing reports on Gloucester Harbor. In response a Preliminary Examination, dated 31 December 1929 was prepared. The study examined proposals to remove Round Rock Shoal to -35 feet MLW (58,150 cy rock est.), remove the Outer Harbor Ledges (Prairie Ledge (2,000 cy rock), Mayflower Ledge (5,300 cy rock), Tenpound Ledge (13,100 cy rock), and Ledges F & I (20,000 cy rock total)), all to -30 feet MLW, dredging the approaches to wharves in the Inner Harbor to -20 feet MLW with removal of numerous ledges all to -20 feet MLW (14,550 cy rock est.), removal of Ledge M at the entrance to the Blynman Canal, removal of two ledges off the Rocky Neck ferry landing to -10 feet MLW (100 cy rock est.) and channel improvements to straighten and deepen the Annisquam River waterway. The report only examined the removal of the various ledges in detail, leaving out any estimates for improvements to the Annisquam waterway. This report was returned unpublished with instructions to prepare a joint report covering both Gloucester Harbor and the Annisquam River, for which separate investigating authorization had been supplied by Congress. This report, the plan for wich is shown in Figure E-5, formed the basis for the report published in 1932 and discussed below.

In March of 1931, a series of severe storms displaced many capstones and wall stones from the breakwater's superstructure. A letter report, dated April 29, 1931, described the damage to 110 LF of superstructure and 370 LF of apron, and proposed repairs consisting of resetting 470 tons of fitted stone, placing 25 tons of new rubble-stone in the superstructure core, rehandling and placing 500 tons of the heavy rubble stone apron and placing 1,015 tons of new heavy rubble stone into the apron to restore its elevation. Repairs were carried out under contract in November and December 1931 with 511 tons of fitted stone being reset and 1,223 tons of new heavy rubble stone placed in the apron (AR 1932, Pg. 42). Further repairs were carried out under contract between December 1933 and March 1934 and required resetting 970 tons of fitted stone in 110 LF of superstructure, and placement of 30 tons of new rubble-stone core and 1,250 tons of new heavy rubble-stone in 1,100 LF of the apron (AR 1934, Pg. 35). The specifications sheet for the 1933 repairs is shown in Figure E-6.

The River and Harbor Act of 3 July 1930 and a House Committee on Rivers and Harbors resolution adopted 27 February 1929 both called for a review of reports on Gloucester Harbor. The reports responding to these were printed in House Committee on Rivers and Harbors Document #39, 72nd Congress, 1st Session, transmitted 29 June 1932. A Preliminary Examination, dated 30 September 1930 recommended the improvement of both the Inner Harbor

and the Annisquam River waterway. The study examined proposals to improve the Outer Harbor and Inner Harbor and to take over the and improve the Annisquam River waterway as part of the Intracoastal Waterway System. Improvements contemplated in the Outer Harbor included the removal of Round Rock Shoal to -35 feet MLW (58,150 cy rock est.), and the removal of Prairie Ledge (2,000 cy rock), Mayflower Ledge (5,300 cy rock), Tenpound Ledge (13,100 cy rock), and Ledges F & I (20,000 cy rock total), all to -30 feet MLW and the removal of Ledge M at the entrance to the Blynman Canal, removal of two ledges off the Rocky Neck ferry landing to -10 feet MLW (100 cy rock est.). Improvements contemplated for the Inner Harbor included dredging the approaches to wharves in the Inner Harbor to -20 feet MLW with removal of numerous ledges all to -18 or -20 feet MLW (14,550 cy rock est.). The District Engineer's Survey Report, dated 29 February 1932 recommended deepening the Inner Harbor channel along the north waterfront to -18 feet MLW (56,100 cy dredging and 1,650 cy rock removal estimated) The Division Engineer's Survey Report, dated 4 April 1932, did not concur in the Inner Harbor recommendation as it found that the wharf owners had yet to deepen their berths to take full advantage of the 15-foot channel along the Inner Harbor waterfront, so that deepening this channel to -18 feet or greater would not be justified. The two reports, however, did recommend adoption of the project for the Annisquam River, including the removal to -8 feet MLW of Ledge M (7 cy rock est.) in the Outer Harbor in the approach to the Blynman Canal, the southern entrance to the waterway. The channel dimension adopted for the Annisquam River were a depth of -8 feet MLW, 60 feet wide from Gloucester Harbor through the Blynman Canal and up to the Railroad Bridge, then 100 feet wide up to the river mouth opposite Annisquam village, then 200 feet across the bar at the river's mouth into Ipswich Bay (47,500 cy estimated). The map from this document showing the proposed improvement considered for the Inner Harbor is shown in Figure E-7. The Annisquam River project was adopted by the River and Harbor Act of 30 August 1935. The project was constructed between August and November of 1936 (91,773 cy removed) (AR 1937, Pg. 41).

Storms again damaged the Dog Bar Breakwater in early 1935 necessitating repairs. A letter report dated 17 August 1935 described the results of a survey of the seaward face apron. These repairs were carried out under contract in November and December 1935 when 2,013 tons of new heavy rubble stone were placed in the apron (AR 1936, Pg. 49).

Storm damage resulted in another condition survey of the breakwater in December 1938, as detailed in a letter report dated January 5, 1939, which found 130 LF of capstone had been displaced and the heavy rubble-stone apron had been reduce in top elevation by about 2 feet. This damage required further breakwater repairs which were carried out under contract between May and July 1939. This required resetting 1,049 tons of fitted stone in the superstructure and placement of 3,000 tons of new heavy rubble stone in the seaward face apron (AR 1939, Pg. 40 and AR 1940, Pg. 35).

A House Committee on Rivers and Harbors resolution, adopted 8 October 1938, called for further examination of Gloucester Harbor and the Annisquam River. The Preliminary Examination, dated 11 December 1939, investigated removal of additional ledge areas in Gloucester Harbor and the widening of channel bends and dredging of two -8-foot MLW anchorage areas along the Annisquam River at Lobster Cove, one at 27.5 acres in the cove and a second at 4.3 acres located west of the Annisquam Yacht Club, and deepening the Annisquam entrance channel over the bar at Ipswich Bay. The report concluded that further study of removal of ledge areas in Gloucester's Inner Harbor as requested was not justified based on vessel traffic. The report did, however, recommend further study of potential anchorage improvements to the Annisquam River at Lobster Cove, and concluded that the desired channel bend widening could be accomplished under operations and maintenance authority for the 1935 project.

A Letter Report, dated 4 May 1940, detailed the results of a condition survey of the Dog Bar Breakwater following a severe storm in March 1940, and found a damaged section requiring repairs. Resetting of capstone and placement of additional rubble stone in the apron were recommended. The repairs were approved by the Chief of Engineers on 9 May 1940. The repairs were carried out in August of 1940 and was confined to resetting 3 cap stones and repinning several courses of superstructure along the damaged section (AR 1941, Part 1, Pg. 39).

Maintenance of the Ipswich Bay Bar entrance of the Annisquam River channel was undertaken by Corps hopper dredge in August 1940 with dredging to a depth of -8 to -10 feet MLW removing 50,446 cy. A more general maintenance dredging of 53,104 cy from the remainder of the Annisquam River channel was undertaken in September to November 1940, and also included the bend widening modification as recommended in the 1939 Preliminary Examination. (AR 1941, Part 1, Pg. 39).

The Survey/Reexamination Report for Lobster Cove, dated 5 August 1940, as recommended in the 11 December 1939 Preliminary Examination, was published in House Doc. #329, 77th Congress, 1st Session, dated 28 July 1941, in response to the 8 October 1938 House Committee resolution. The report considered, widening the Annisquam River channel across the bar at Ipswich Bay, widening and deepening to -12 feet MLW by generally 200 feet wide through the entire Annisquam Waterway, an anchorage in Stage Cove at -8 feet MLW by 2.6 acres, and various anchorage configurations in Lobster Cove of up to 32 acres and extended as far up as the Annisquam bridge. The report recommended only one feature, an anchorage in Lobster Cove at 17.3 acres by -8 feet MLW (216,000 cy estimated). The improvement was authorized by the River and Harbor Act of 2 March 1945. Construction of this improvement began in September 1958 and was completed by November 1958, with 184,120 cy removed (AR 1959, Vol. 2, Pg. 16).

Further maintenance dredging of the Annisquam River was undertaken in January to May 1949, with 33,302 cy removed (AR 1949, Part 1, Pg. 51). Maintenance dredging of this channel was again accomplished in June to November 1957 with a total of 51,540 cy removed (AR 1957, Vol. 2, Pg. 20 and AR 1958, Vol. 2, Pg. 12).

Two resolutions of the House Committee on Public Works, adopted 30 March 1955, called for further examination of Gloucester Harbor with a view to deepening the Inner Harbor to -20 feet MLW. A Preliminary Examination, for which a map & plan dated 15 August 1957, including a probing layout but no actual report, was found in New England Division records, show that a channel -30 feet MLW with a large turning basin in the center of the Inner harbor was considered. This plan is shown in Figure E-8. The responding Survey Report, dated 21 December 1961, was published in House Doc. #341, 87th Congress, 2d Session, dated 12 February 1962. The report considered harbor improvements consisting of the following: dredging an access channel into the public landing in Freshwater Cove, dredging a Main Harbor Channel at widths of 300 or 600 feet wide by up to -22 feet MLW with a turning basin off the northern wharves, branch channels along the northern and southern waterfronts, deepening of Harbor Cove with additional anchorage development, and additional anchorage areas in Smith Cove and off the west end of the state pier. The report recommended a project, as shown in Figure E-9, consisting of: a main entrance channel 300 feet wide by -20 feet MLW leading to a turning basin of the same depth and 600 feet wide in the center of the Inner Harbor, a branch access channel 200 to 250 feet wide by -20 feet MLW along the northern waterfront, a second branch access channel at -20 feet MLW by 200 feet wide extending southeast of the state pier, an anchorage in lower Smith Cove at -16 feet MLW by 300 to 650 feet wide, an anchorage 100

to 500 feet wide extending along the channel north of Fort Point and into and through Harbor Cove at -18 feet MLW, a 10-acre by -10-foot MLW anchorage between the branch channels west of the state pier, a 5-acre by -15 foot MLW anchorage east of Harbor Cove and the removal of a Ledge east of the harbor Cove entrance to -24 feet MLW. These improvements were authorized by the River and Harbor Act of 23 October 1962. Construction was accomplished, in accordance with a Design Memorandum, dated 27 May 1964, between October 1964 and July 1965, with 152,500 cy of ordinary material and 1,010 cy of rock removed (AR 1965, Vol. 2, Pg. 20). The project plans and specifications drawings are shown in Figure E-10A and B.

Maintenance dredging of the Annisquam River has been undertaken an additional five times since 1965 as shown below. Also maintenance dredging of the 15-foot Inner Harbor channel was carried out between July and October 1961 with 28,000 cy removed (AR 1962, Vol. 2, Pg. 21).

Annisquam River	July to Oct 1965	19,536 cy	(AR 1966, Vol. 2, Pg. 17)
Annisquam River	1967	Boulder Removal	(AR 1967, Vol. 2, Pg. 20)
Bar Channel	June 1970	7,500 cy	(AR 1970, Vol. 2, Pg. 8)
Annisquam River	August to Oct 1972	65,000 cy	(AR 1973, Vol. 2, Pg. 1-10)
Bar Channel (Sidecast)	April to May 1976	2,600 cy	(AR 1976, Vol. 2, Pg. 1-9)

Repairs to the Dog Bar Breakwater were accomplished in November 1965 to March 1966 with 10,916 tons of heavy rubble stone placed along the face of the structure. (AR 1966, Vol. 2, Pg. 17). The specifications plan for these repairs is shown in Figure E-11. The next and most recent repairs to the breakwater were undertaken by contract between June and August 1981, when resting of some stones in the seaward armor apron was accomplished together with placement of about 1,600 tons of new armor stone in the apron with sizes of 6 to 12 tons. The specifications plan for this work is shown in Figure E-12. (AR 1981, Pg. 1-6).

In response to a request from the City of Gloucester, dated 11 March 1981, an Initial Appraisal study was undertaken under the Section 107 continuing authority to examine improvements to Smith Cove for the benefit of the harbor's inshore lobster fleet. The report, published on 16 May 1983 and approved by OCE on 29 June 1983, considered providing a channel -8 feet MLW by 75 feet wide extending about 750 LF from the head of the -16-foot lower Smith Cove anchorage to an anchorage -8 feet MLW by 3 acres at the public landing area at the head of Smith Cove, and recommended a full reconnaissance study be performed. A reconnaissance study, requested by the city of Gloucester on 3 November 1983, examined the same improvement scheme. The Reconnaissance Report, dated 6 March 1984, recommended that a detailed project study be performed, and was approved by OCE on 20 April 1984.

A Detailed Project Report, dated 28 February 1990, recommended dredging and rock removal to form a channel -8 feet MLW by 80 feet wide extending southwesterly from the existing 16-foot channel along the west side of the cove to an anchorage 2.5 acres by -8 feet MLW at the head of Smith Cove (33,000 cy ordinary material and 1,000 cy rock estimated). The report was approved by OCE on 28 August 1990. During preparation of Plans and Specifications for the project, a mitigation plan for intertidal impacts was developed and changes in sediment evaluation procedures forced a change in disposal strategy from ocean disposal to upland disposal. The continuing inability of the state or city to secure an acceptable upland disposal site for the dredged material forced the project to be placed in a deferred status in April 1995.

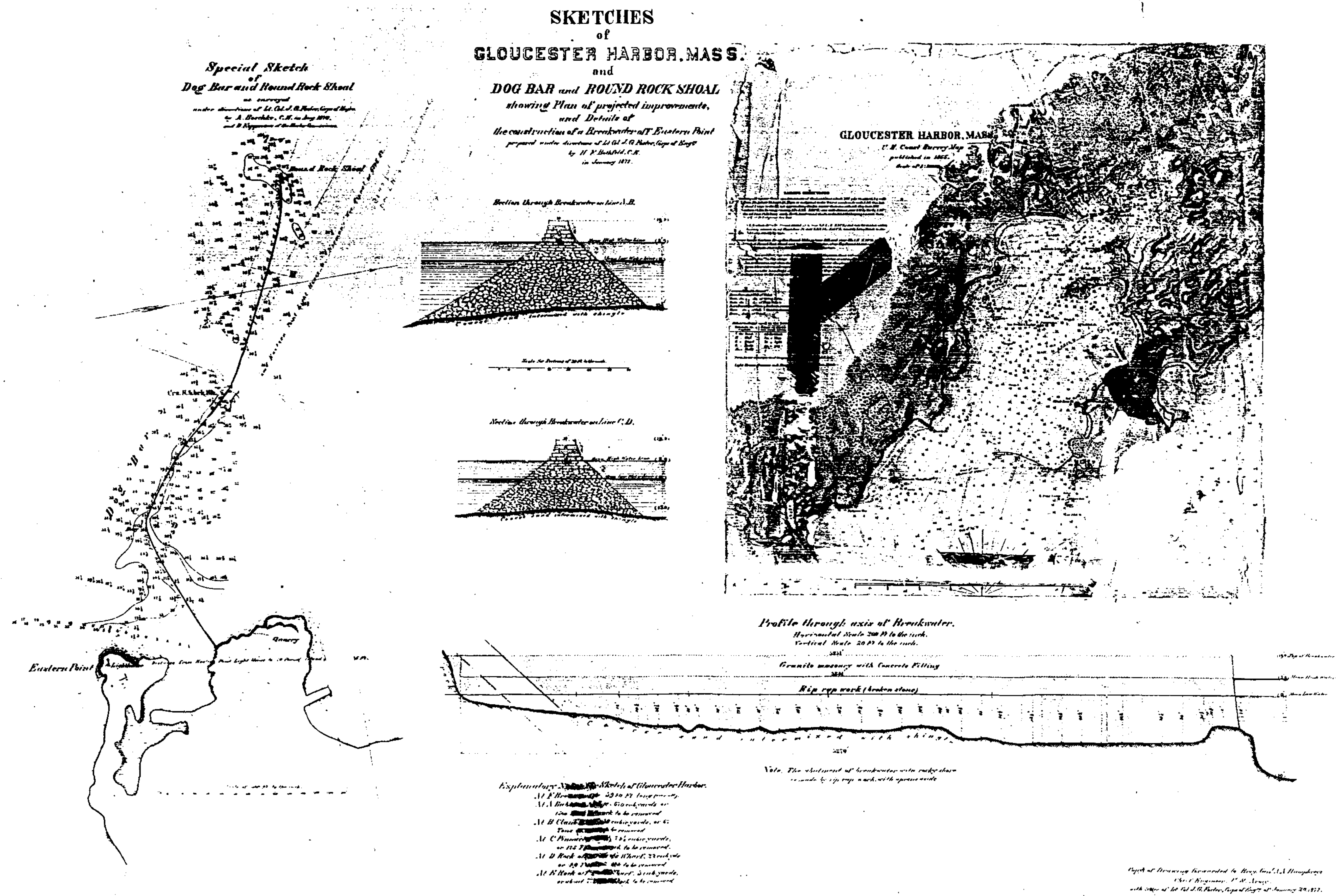
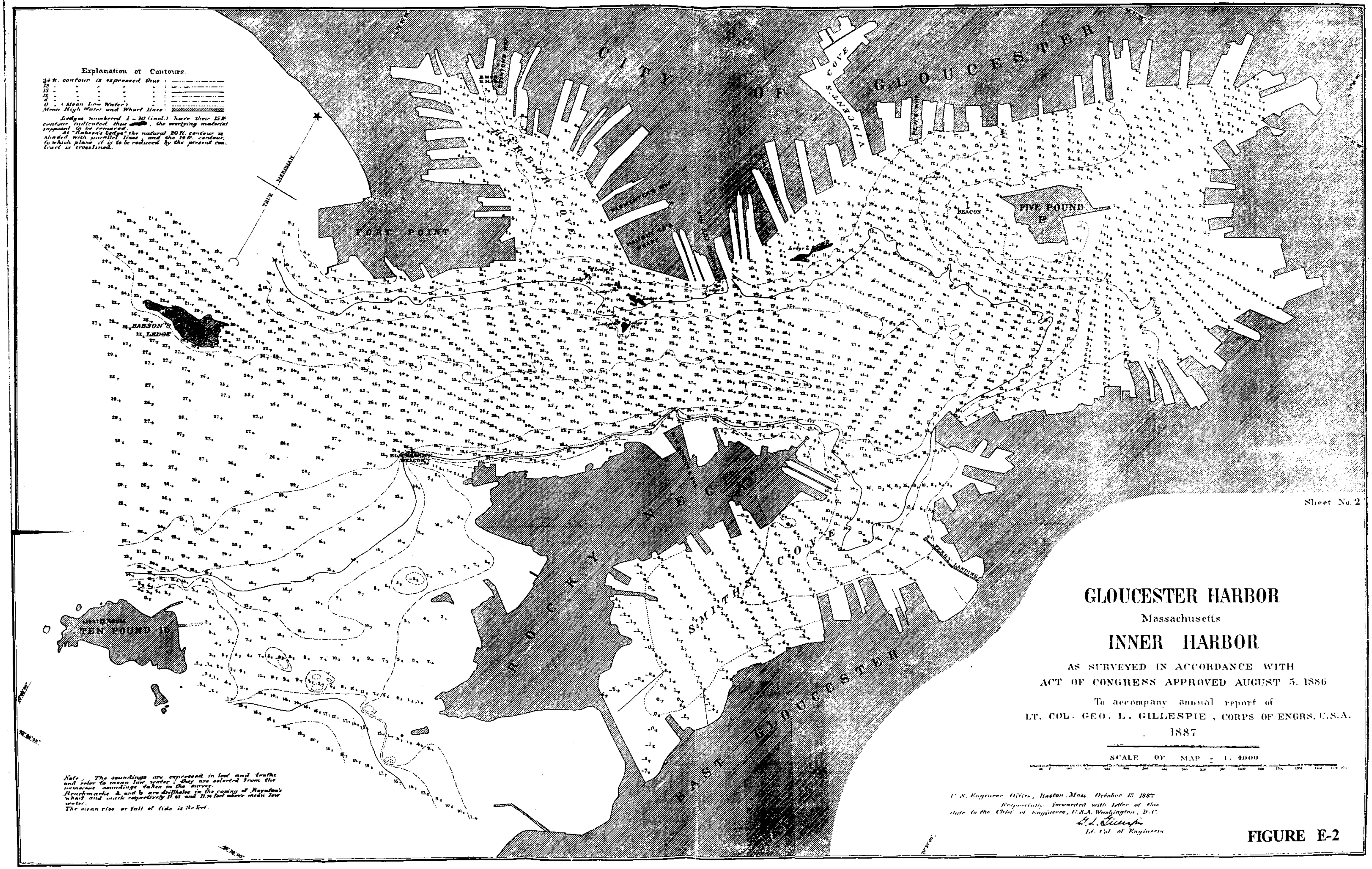


FIGURE E-1

Drawer No. 5
Sheet No. 1



Explanation of Contours.
24 ft. contour is expressed thus
18
15
12
6
0 (Mean Low Water)
Mean High Water and Wharf lines
Ledges numbered 1 – 10 (incl.) have their 15 ft. contour indicated thus , the overlying material supposed to be removed.
At "Babson's Ledge" the natural 20 ft. contour is shaded with parallel lines, and the 14 ft. contour, to which plane it is to be reduced by the present contract is crosslined.
TRUE MERIDIAN
CITY OF GLOUCESTER
FORT POINT
HARBOR COVE
VINCENT'S COVE
FIVE POUND I.
BEACON
BABSON'S LEDGE
TEN POUND ID.
ROCKY NECK
SMITH'S COVE
EAST GLOUCESTER
FERRY LANDING
Sheet No. 2
GLOUCESTER HARBOR
Massachusetts
INNER HARBOR
AS SURVEYED IN ACCORDANCE WITH
ACT OF CONGRESS APPROVED AUGUST 5, 1886
To accompany annual report of
LT. COL. GEO. L. GILLESPIE, CORPS OF ENGRS. U.S.A.
1887
SCALE OF MAP 1: 4000
Note. The soundings are expressed in feet and tenths and refer to mean low water; they are selected from the numerous soundings taken in the survey.
Benchmarks a and b are drillholes in the coping of Boynton's wharf and mark respectively 11.43 and 11.36 feet above mean low water.
The mean rise or fall of tide is 9.0 feet.
U.S. Engineer Office, Boston, Mass. October 15 1887
Respectfully forwarded with letter of this date to the Chief of Engineers, U.S.A. Washington, D.C.
G. L. Gillespie
Lt. Col. of Engineers.

FIGURE E-2

GLOUCESTER HARBOR

MASSACHUSETTS

To accompany annual report of

LT. COL. GEO. L. GILLESPIE

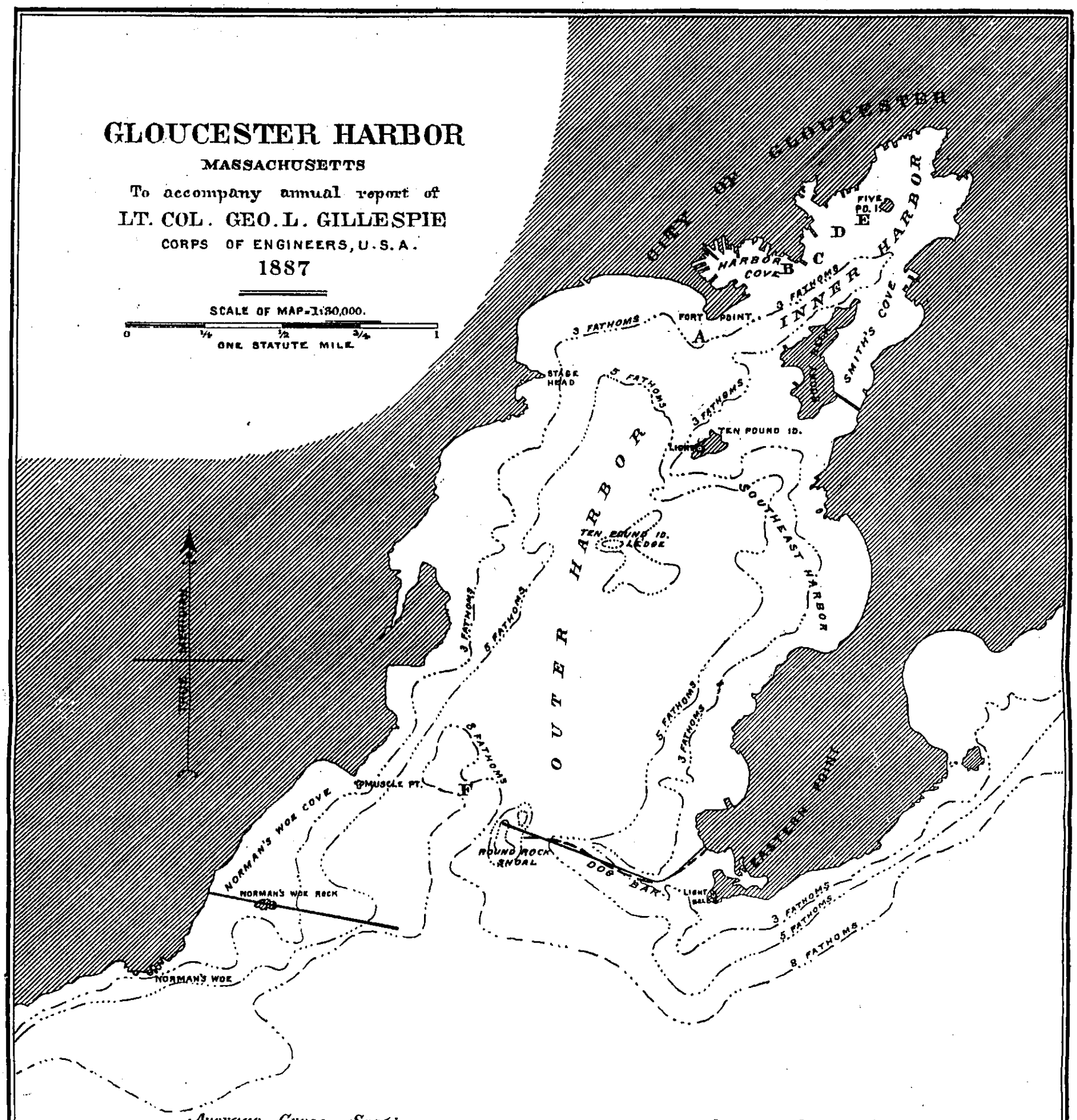
CORPS OF ENGINEERS, U.S.A.

1887

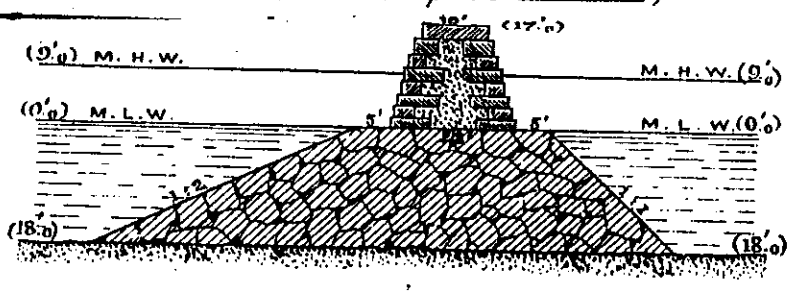
SCALE OF MAP-1:30,000.

0 1/4 1/2 3/4 1

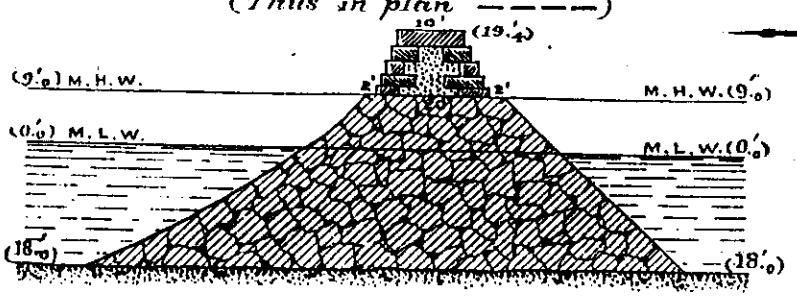
ONE STATUTE MILE



Average Cross Section
Project of 1884
(Thus in plan ————)



Average Cross Section
Project of 1871
(Thus in plan – – – –)



PROPOSED BREAKWATERS

Scale 1:450.

5 0 10 20 30 40 50 60 70 80 90 100 Ft.

At A, Babson's Ledge
B Clam Rock
C Pinnacl "
D Rock off Friend's Wharf
E " " Pew's
F Reef off Muscle Point

U. S. Engineer Office, Boston, Mass. July 30, 1887.

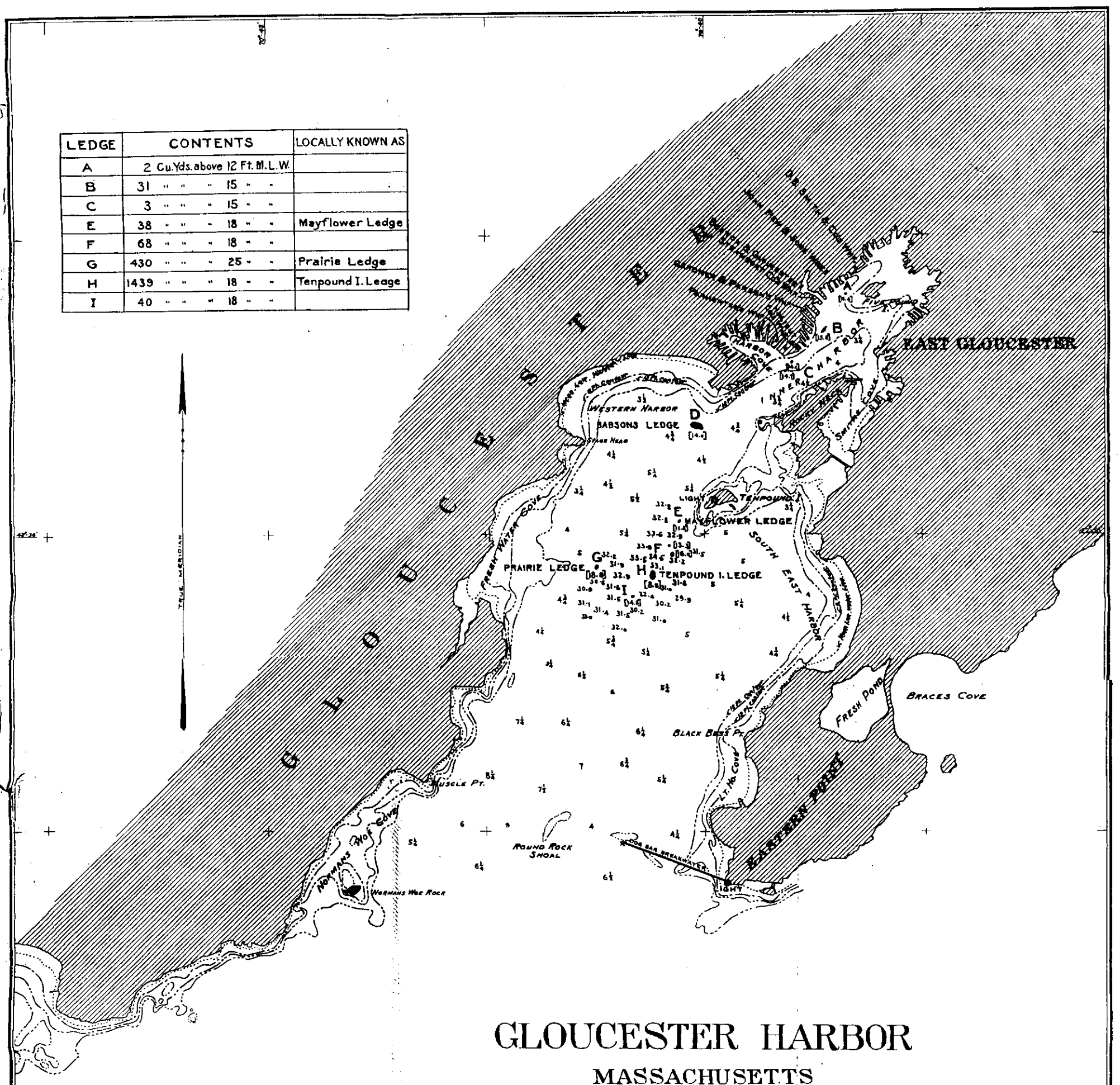
Respectfully forwarded to the Chief of Engineers with Letter of this date

G. L. Gillespie

Lt. Col. of Engineers.

FIGURE E-3

LEDGE	CONTENTS	LOCALLY KNOWN AS
A	2 Cu.Yds. above 12 Ft. M.L.W.	
B	31 " " " 15 " "	
C	3 " " " 15 " "	
E	38 " " " 18 " "	Mayflower Ledge
F	68 " " " 18 " "	
G	430 " " " 25 " "	Prairie Ledge
H	1439 " " " 18 " "	Tenpound I. Leage
I	40 " " " 18 " "	



GLOUCESTER HARBOR

MASSACHUSETTS

SURVEY MADE IN ACCORDANCE WITH RIVER AND HARBOR ACT OF MARCH 2, 1907 UNDER THE DIRECTION OF LIEUT. COL. EDW. BURR, CORPS OF ENGINEERS, U. S. A.

JULY – OCTOBER, 1908

Scale of Map

STATUTE MILES

—Note—

The general outline of this map was traced from U.S.C. & G.S. Chart No. 334, Gloucester Harbor.

Soundings taken during this survey are expressed in feet and tenths and are referred to the plane of mean low water.

The least sounding obtained on each ledge surveyed is inclosed in brackets thus, – [16.0]

Soundings traced from C.S. Chart are expressed in fathoms.

U.S. Engineer Office, Boston, Mass.
October 31, 1908.
Respectfully forwarded to the Chief of Engineers, U.S.A.
with report of this date.

Lieut. Col. Corps of Engineers.

Survey made by M.E. Warren, Junr. Eng'r.

J.R. ROBERTSON, OCTOBER, 1908

FIGURE E-4

WAR DEPARTME[illegible]

CORPS OF ENGINEERS U. S. ARMY

GLOUCESTER HARBOR, MASSACHUSETTS

Scale of Feet 1000 0 1000 2000 3000 4000 5000 FT.

U.S. ENGINEER OFFICE, BOSTON, MASS. SEPT. 27, 1929

Submitted: Edward L. Munson, Engineer

Approved: D. C. Cheney, Col. Corps of Engineers

Drawn: A.B.C.

Submitted with report dated Dec. 31, 1929.

File No. 126 Dr. 36

Note: Soundings are in feet and refer to M.L.W.

Copied from U.S.C.&G.S. chart No. 243

GLOUCESTER

D.B. Smith & Co's Wharf

Pews Wharf

Dredged to 8 ft. M.L.W. by Commonwealth of Mass.

Ledges "B" and "C" removed by the U.S. Engineer Dept. to a depth of 15 ft. at M.L.W.

Vincent Cove

Dredged to 15 ft. at M.L.W. by the Commonwealth of Massachusetts.

Channel dredged to 16 ft. at M.L.W. by the Commonwealth of Massachusetts.

Ledge P

Ledge "A" removed to 12 ft. at M.L.W. by the U.S. Engineer Dept. in 1916.

Ledge A removed to 16 ft. at M.L.W. by the Commonwealth of Massachusetts in 1922.

Channel dredged to 12 ft. at M.L.W. by the Commonwealth of Massachusetts

Ledge J

Ledge B

Ledge K

Ledge L

Ledge M

INNER HBR

EAST GLOUCESTER

Channel dredged to 15 ft. at M.L.W. by U.S. Engineer Dept.

Channels dredged to depths from 5 to 14 ft. at M.L.W. by the Commonwealth of Massachusetts

Ft. Point

Rocky Neck

Smith Cove

WESTERN HBR

Stage Head

Babson's Ledge

Black Rk

Tenpound I.

Ledges "E", "F", "H" and "I" removed by the U.S. Engineer Dept. to a depth of 18 ft. at M.L.W.

Field Rks

Freshwater Cove

Ledge E.

Mayflower Ledge

Ledge F.

Prairie Ledge

Ledge H.

Tenpound Ledge

SOUTHEAST HARBOR

Ledge G

Ledge I

"Ledge G" removed by the U.S. Engineer Dept. to a depth of 25 ft. at M.L.W.

42°35

70°42'

70°40'

Niles Pond

Brace Cove

Black Bess Pt.

Black Bess Rks

Lighthouse Cove

Eastern Point

Ledge N

Round Rock Shoal

Dog Bar

Dog Bar Breakwater

Normans Woe Cove

Normans Woe Rks

E. Point Ledge

B. & M. R. R.

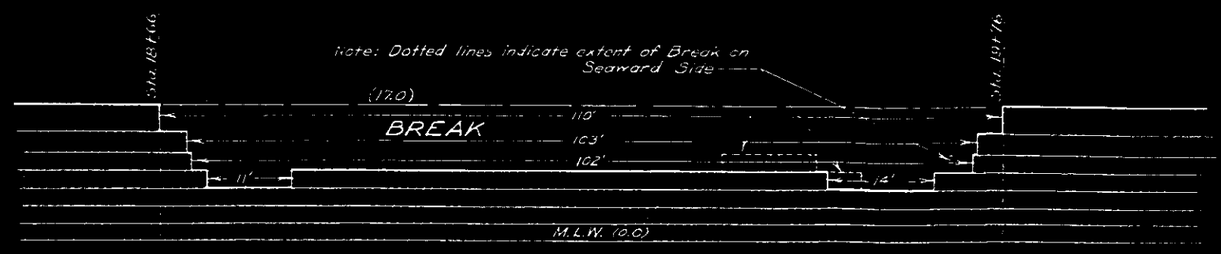
True North

ATLANTIC OCEAN

FIGURE E-5

WAR DEPARTMENT

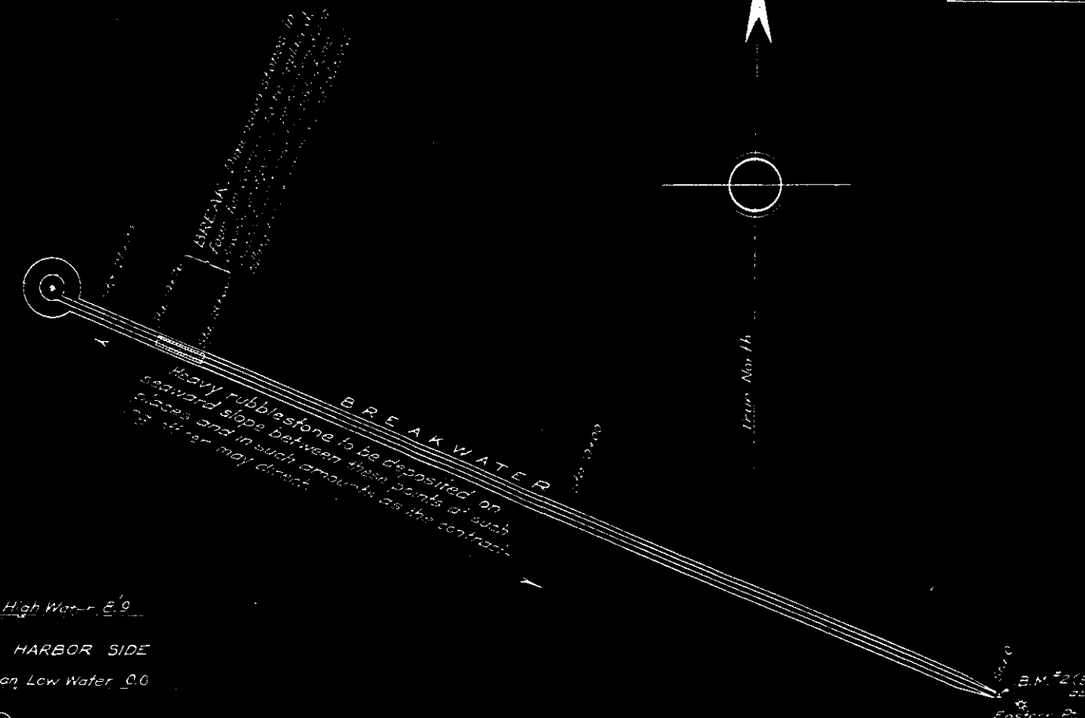
CORPS OF ENGINEERS, U.S. ARMY.

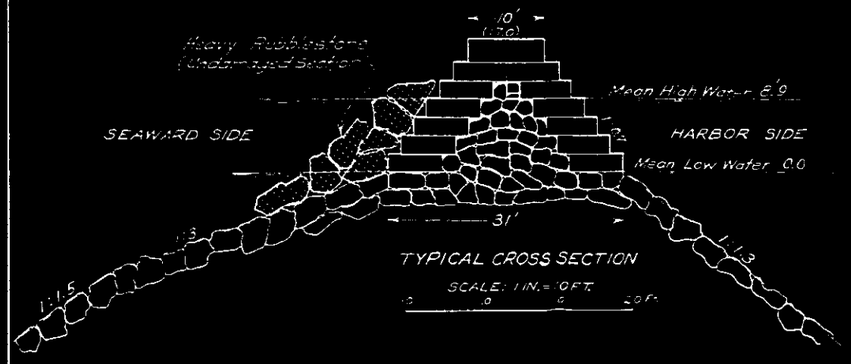


ELEVATION
(HARBOR SIDE)
SCALE 1" = 10 FT.

SUBSKETCH OF
GLOUCESTER HARBOR, MASS.
Scale 1:20000

Traced from U.S.C.&G.S. Chart No. 243.





To accompany specifications dated

GLOUCESTER HARBOR, MASS.
REPAIRS TO BREAKWATER

IN ONE SHEET — SCALE 1" = 200'

U.S. Engineer Office, Boston, Mass., June 21, 1933.

Submitted: Daniel A. Poole, Associate Engineer

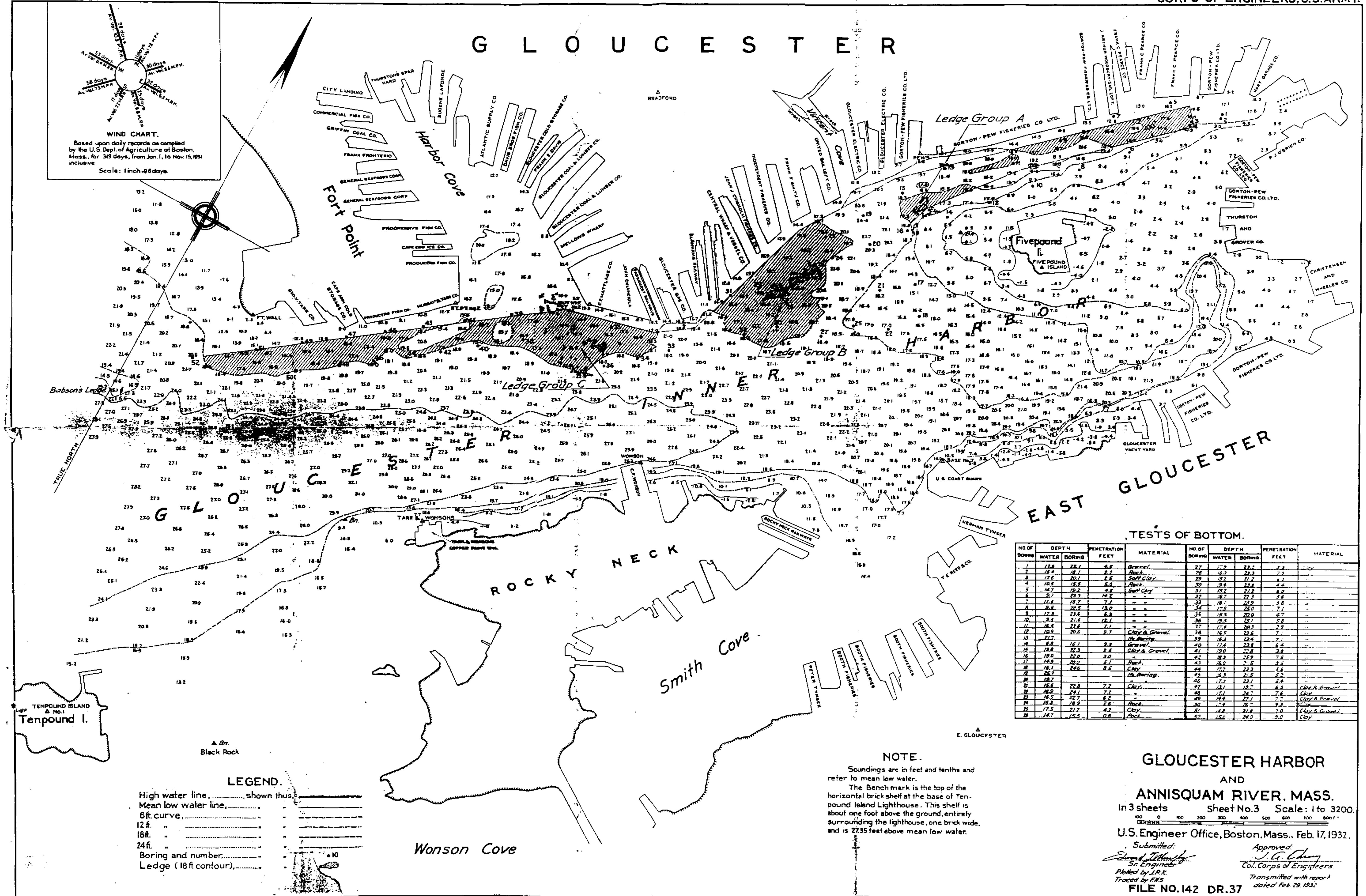
Approved: [illegible], Lieut. Colonel of Engineers

Approval recommended: Edward Markley, Senior Engineer

Drawn by B.E.M.

FIGURE E-6

FILE NO. 151, DR. 36.



TESTS OF BOTTOM.

NO. OF BORING	DEPTH WATER	DEPTH BORING	PENETRATION FEET	MATERIAL	NO. OF BORING	DEPTH WATER	DEPTH BORING	PENETRATION FEET	MATERIAL
1	17.6	22.1	4.5	Gravel.	27	17.9	23.2	5.3	Clay
2	15.4	18.1	2.7	Rock.	28	16.3	23.3	7.0	"
3	17.6	20.1	2.5	Soft Clay.	29	15.2	21.2	6.0	"
4	10.5	15.5	5.0	Rock.	30	19.4	23.8	4.4	"
5	14.7	19.2	4.5	Soft Clay	31	15.2	21.2	6.0	"
6	9.1	23.3	14.2	" "	32	16.7	22.3	5.6	"
7	11.6	18.7	7.1	" "	33	18.1	23.9	5.8	"
8	9.5	22.5	13.0	" "	34	17.9	25.0	7.1	"
9	17.3	23.6	6.3	" "	35	15.3	20.0	4.7	"
10	9.5	21.6	12.1	" "	36	19.3	25.1	5.8	"
11	16.5	23.6	7.1	" "	37	17.4	20.3	2.9	"
12	10.9	20.6	9.7	Clay & Gravel.	38	16.5	23.6	7.1	"
13	21.7			No Boring.	39	16.3	23.4	7.1	"
14	6.8	16.1	9.3	Gravel.	40	17.4	23.8	6.4	"
15	19.8	22.3	2.5	Clay & Gravel.	41	19.0	22.8	3.8	"
16	19.0	22.0	3.0	"	42	18.3	25.9	7.6	"
17	14.9	20.0	5.1	Rock.	43	18.0	21.5	3.5	"
18	16.1	24.6	8.5	Clay	44	17.7	23.3	5.6	"
19	25.7			No Boring.	45	16.3	21.5	5.2	"
20	19.7			" "	46	17.7	23.1	5.4	"
21	15.6	22.8	7.2	Clay.	47	13.1	19.7	6.5	Clay & Gravel
22	16.9	24.1	7.2	"	48	17.1	24.7	7.6	Clay
23	16.5	22.7	6.2	"	49	14.4	22.1	7.7	Clay & Gravel
24	16.3	18.9	2.6	Rock.	50	17.4	26.7	9.3	Clay
25	17.5	21.7	4.2	Clay.	51	14.8	21.8	7.0	Clay & Gravel
26	14.7	15.5	0.8	Rock.	52	15.0	24.0	9.0	Clay

NOTE.

Soundings are in feet and tenths and refer to mean low water.

The Bench mark is the top of the horizontal brick shelf at the base of Tenpound Island Lighthouse. This shelf is about one foot above the ground, entirely surrounding the lighthouse, one brick wide, and is 27.35 feet above mean low water.

GLOUCESTER HARBOR AND ANNISQUAM RIVER, MASS.

In 3 sheets Sheet No. 3 Scale: 1 to 3200.

U.S. Engineer Office, Boston, Mass., Feb. 17, 1932.

Submitted: Sr. Engineer

Approved: J. G. ... Col. Corps of Engineers

Plotted by J.R.K. Traced by F.W.S.

Transmitted with report dated Feb. 29, 1932

FILE NO. 142 DR. 37

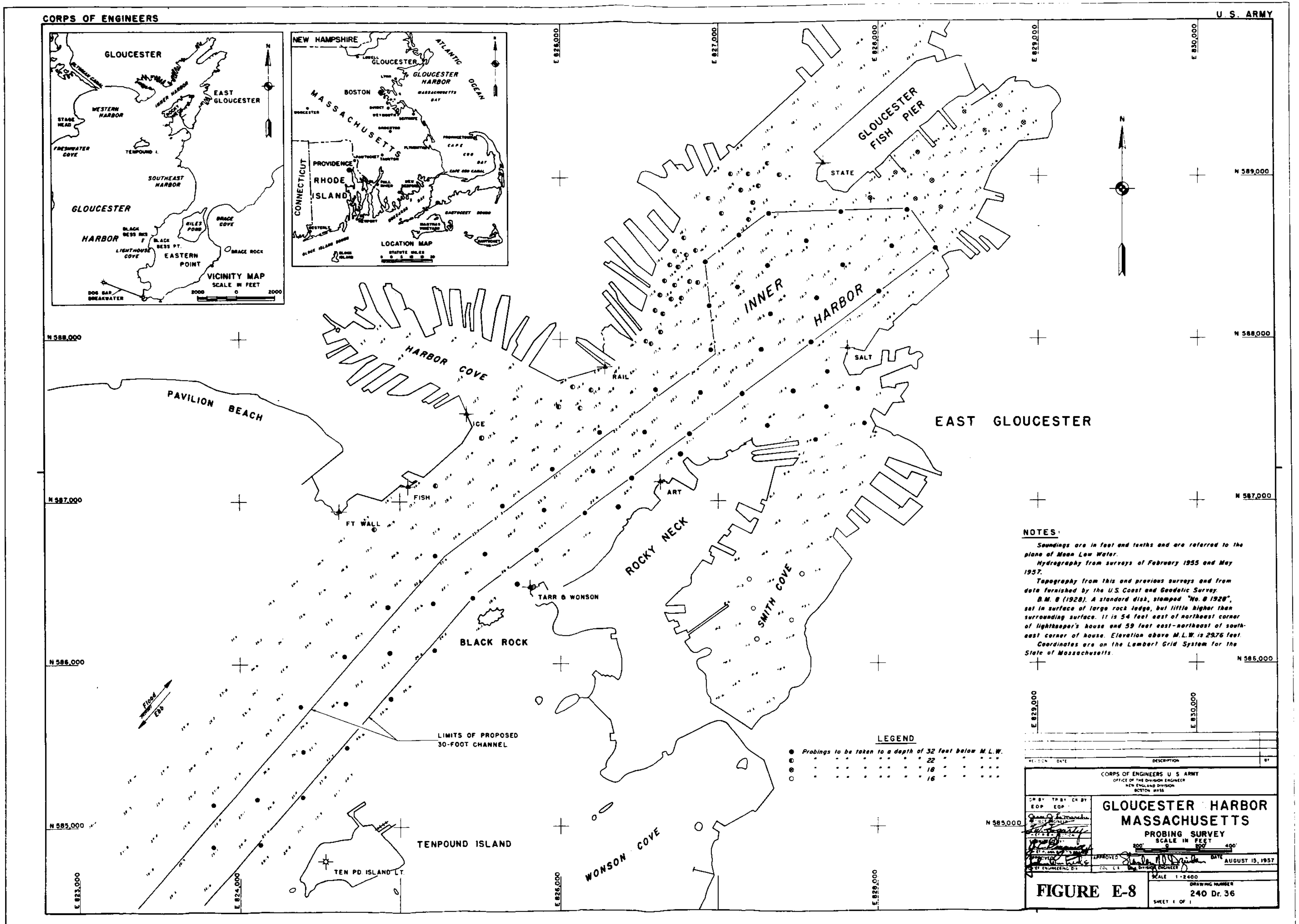

CORPS OF ENGINEERS
U. S. ARMY
GLOUCESTER
WESTERN HARBOR
INNER HARBOR
EAST GLOUCESTER
STAGE HEAD
FRESHWATER COVE
TENPOUND I.
SOUTHEAST HARBOR
GLOUCESTER HARBOR
BLACK BESS RKS
BLACK BESS PT.
LIGHTHOUSE COVE
EASTERN POINT
NILES POND
BRACE COVE
BRACE ROCK
DOG BAR BREAKWATER
VICINITY MAP
SCALE IN FEET
2000 0 2000
NEW HAMPSHIRE
ATLANTIC OCEAN
GLOUCESTER HARBOR
BOSTON
MASSACHUSETTS BAY
MASSACHUSETTS
PROVIDENCE
RHODE ISLAND
CONNECTICUT
CAPE COD BAY
CAPE COD CANAL
LOCATION MAP
STATUTE MILES
E 826,000
E 827,000
E 828,000
E 829,000
E 830,000
N 589,000
N 588,000
N 587,000
N 586,000
N 585,000
E 823,000
E 824,000
GLOUCESTER FISH PIER
STATE
INNER HARBOR
HARBOR COVE
RAIL
SALT
PAVILION BEACH
ICE
EAST GLOUCESTER
FISH
FT WALL
ART
ROCKY NECK
SMITH COVE
TARR & WONSON
BLACK ROCK
Flood
Ebb
LIMITS OF PROPOSED
30-FOOT CHANNEL
TENPOUND ISLAND
TEN PD ISLAND LT
WONSON COVE
NOTES:
Soundings are in feet and tenths and are referred to the plane of Mean Low Water.
Hydrography from surveys of February 1955 and May 1957.
Topography from this and previous surveys and from data furnished by the U.S. Coast and Geodetic Survey.
B.M. 8 (1928). A standard disk, stamped "No. 8 1928", set in surface of large rock ledge, but little higher than surrounding surface. It is 54 feet east of northeast corner of lightkeeper's house and 59 feet east-northeast of southeast corner of house. Elevation above M.L.W. is 29.76 feet.
Coordinates are on the Lambert Grid System for the State of Massachusetts.
LEGEND
Probings to be taken to a depth of 32 feet below M.L.W.
" " " " " " " 22 " " " " "
" " " " " " " 18 " " " " "
" " " " " " " 16 " " " " "
REVISION DATE DESCRIPTION BY
CORPS OF ENGINEERS U. S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION
BOSTON, MASS.
DR BY TR BY CK BY
EOP EOP
GLOUCESTER HARBOR
MASSACHUSETTS
PROBING SURVEY
SCALE IN FEET
200' 0 200' 400'
APPROVED
DATE AUGUST 15, 1957
CHIEF ENGINEERING DIV
COL. C.E. DIVISION ENGINEER
SCALE 1:2400
DRAWING NUMBER
240 Dr. 36
SHEET 1 OF 1

FIGURE E-8

CORPS OF ENGINEERS

U. S. ARMY

IMPROVEMENTS		DEPTHS IN FEET	
		CONSIDERED	RECOMMENDED
(1)	ENTRANCE CHANNEL AND NORTH CHANNEL	20 & 22	20
(2)(2a)	SOUTH CHANNEL	18 & 20	20
(3)	SMITH COVE CHANNEL	16	16
(4)	EMPIRE WHARF LEDGE	NOT CONSIDERED	
(5)	HARBOR COVE - INNER	18 & 20	18
(6)	HARBOR COVE - OUTER	18 & 20	18
(7)	HARBOR COVE ANCHORAGE	15	15
(8)	INNER HARBOR ANCHORAGE	16	16
(9)	REMOVAL OF ROCK SHOAL	24 & 25	24

GLOUCESTER

EXISTING 15-FT. CHANNEL

PEW'S WHARF

QUINCY MARKET COLD STORAGE & WAREHOUSE CO.

GLOUCESTER FISH PIER

NORTH CHANNEL - 20 FEET DEEP (1)

(8) ANCHORAGE 16 FEET DEEP

(2) SOUTH CHANNEL 20 FEET DEEP

(2a)

(3) CHANNEL 16 FEET DEEP

UNITED SEA FOODS WHARF

DAVIS BROS. FISHERIES CO.

EXISTING 10-FT. CHANNEL

EMPIRE WHARF CO.

HARBOR COVE (5) 18 FEET DEEP

(4)

(7) ANCHORAGE 15 FEET DEEP

FORT POINT

(6) CHANNEL - 18 FEET DEEP

(9)

ENTRANCE CHANNEL - 20 FEET DEEP (1)

ROCKY NECK SHIPYARDS, INC.

ROCKY NECK

SMITH COVE

GLOUCESTER EAST

BLACK ROCK

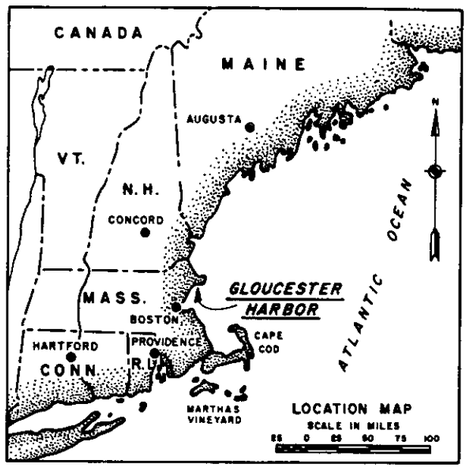
REMOVE LEDGE 24 FEET DEEP

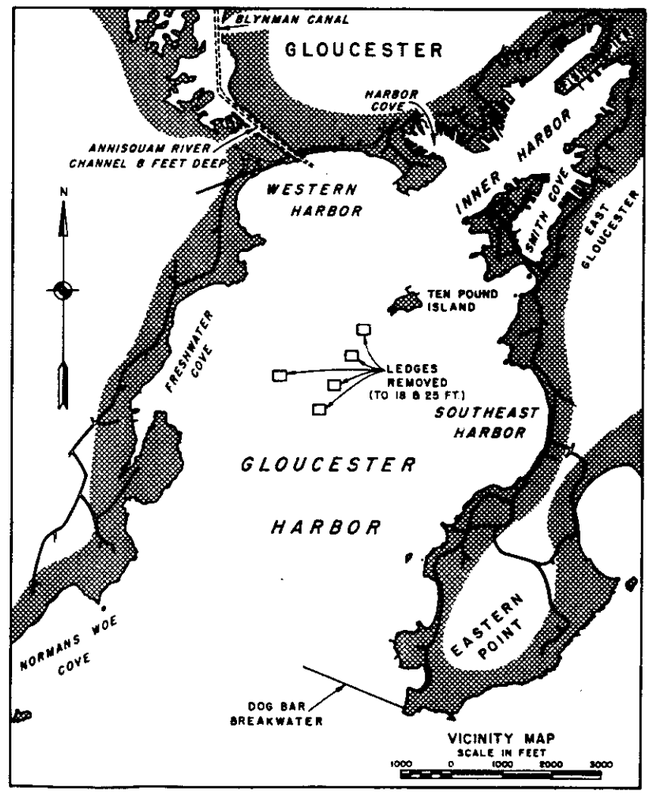
TEN POUND ISLAND

LEGEND

Existing project ——

Recommended improvement — — —





REVISED MARCH 21, 1961

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

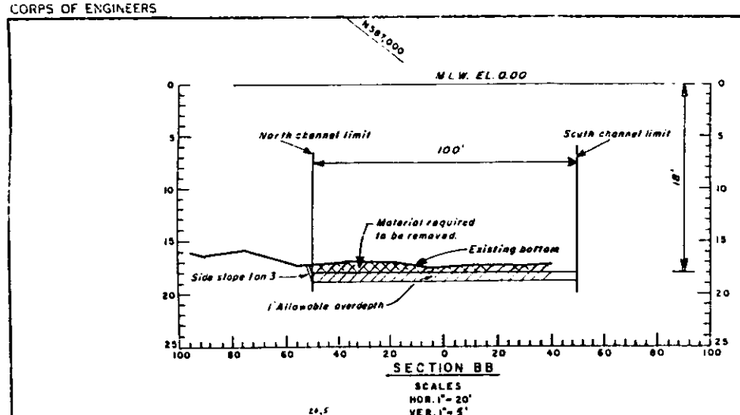
GLOUCESTER HARBOR, MASS.
INNER HARBOR
SCALE IN FEET

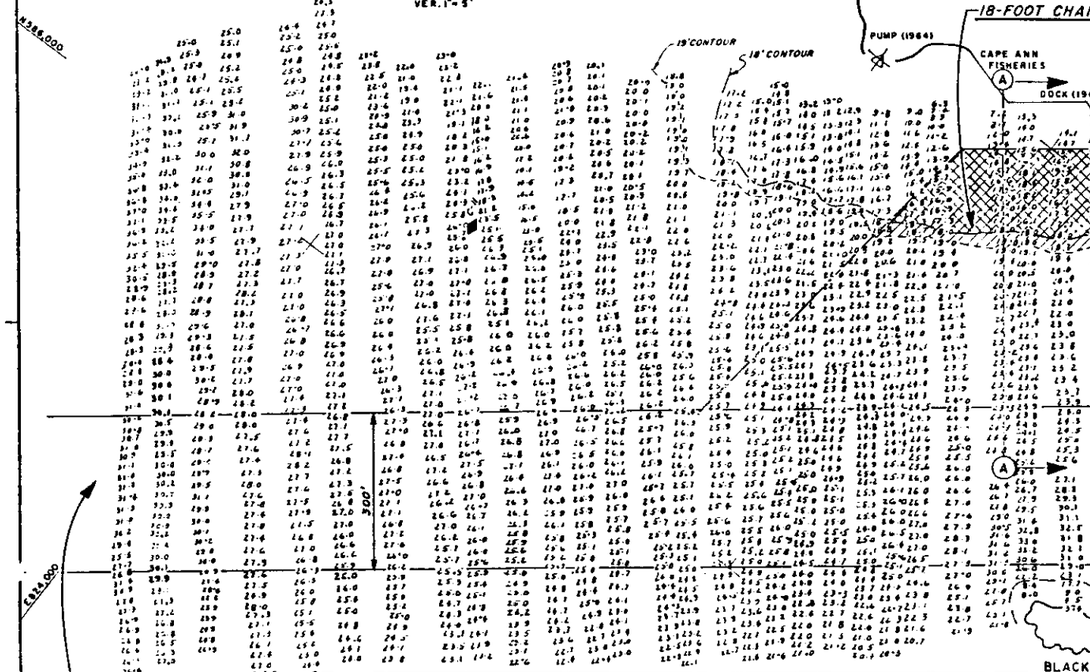
TO ACCOMPANY SURVEY REPORT DATED DEC. 21, 1960

FILE NO. 261 Dr. 36

FIGURE E-9

CORPS OF ENGINEERS





U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	LO. BY
S.J.B	S.J.B	C.F.

GLOUCESTER HARBOR
MASSACHUSETTS
SOUNDINGS
SCALE IN FEET
100 0 100 200 300

APPROVED: Chief, Engineering Division
DATE: JUNE 1964

SCALE 1"=200 | SPEC. NO. NAE-9 | 4-64-81
DRAWING NUMBER
266-Dr.-37
SHEET 2 OF 7

FIGURE E-10A

CORPS OF ENGINEERS

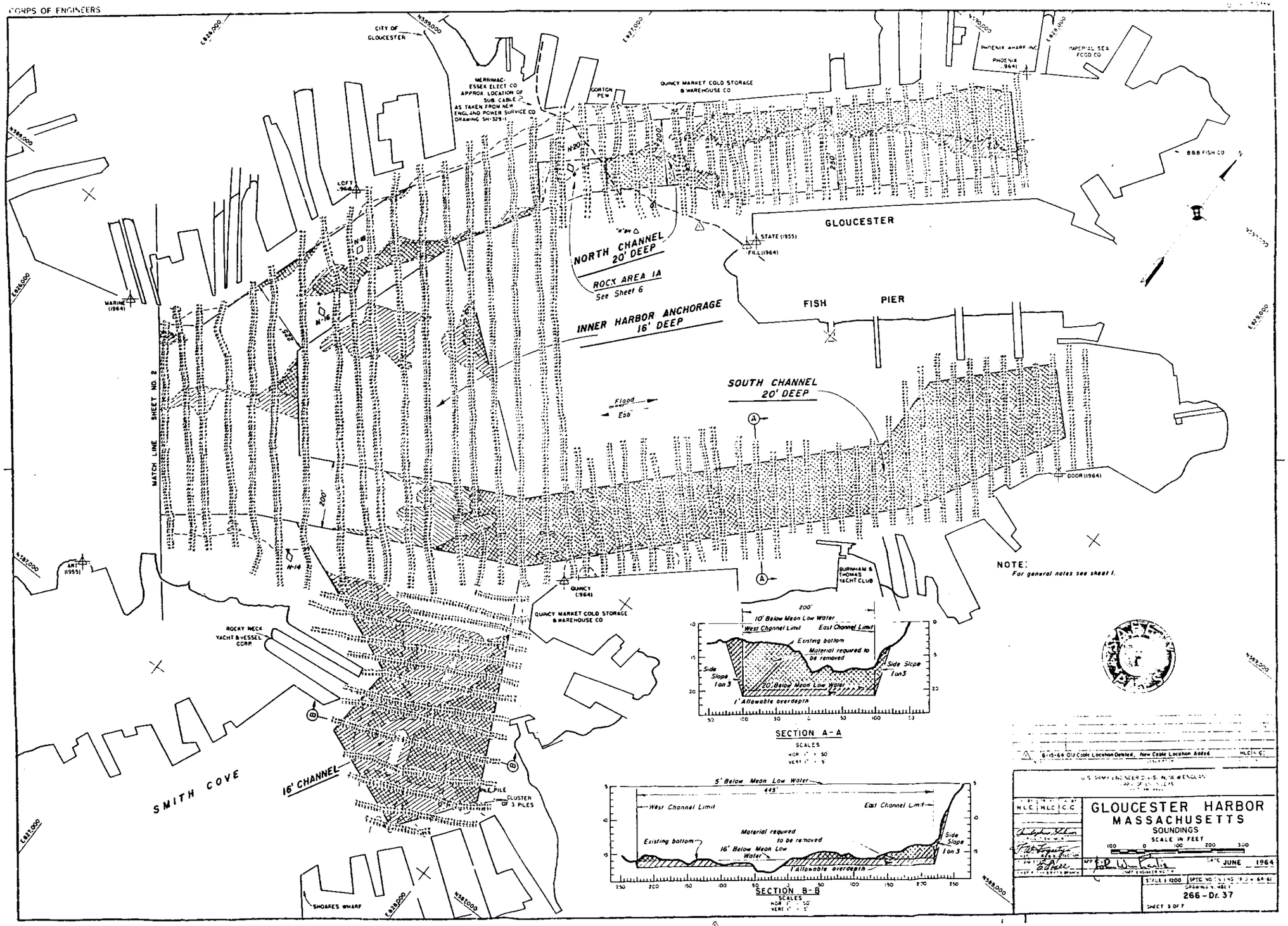


FIGURE E-10B

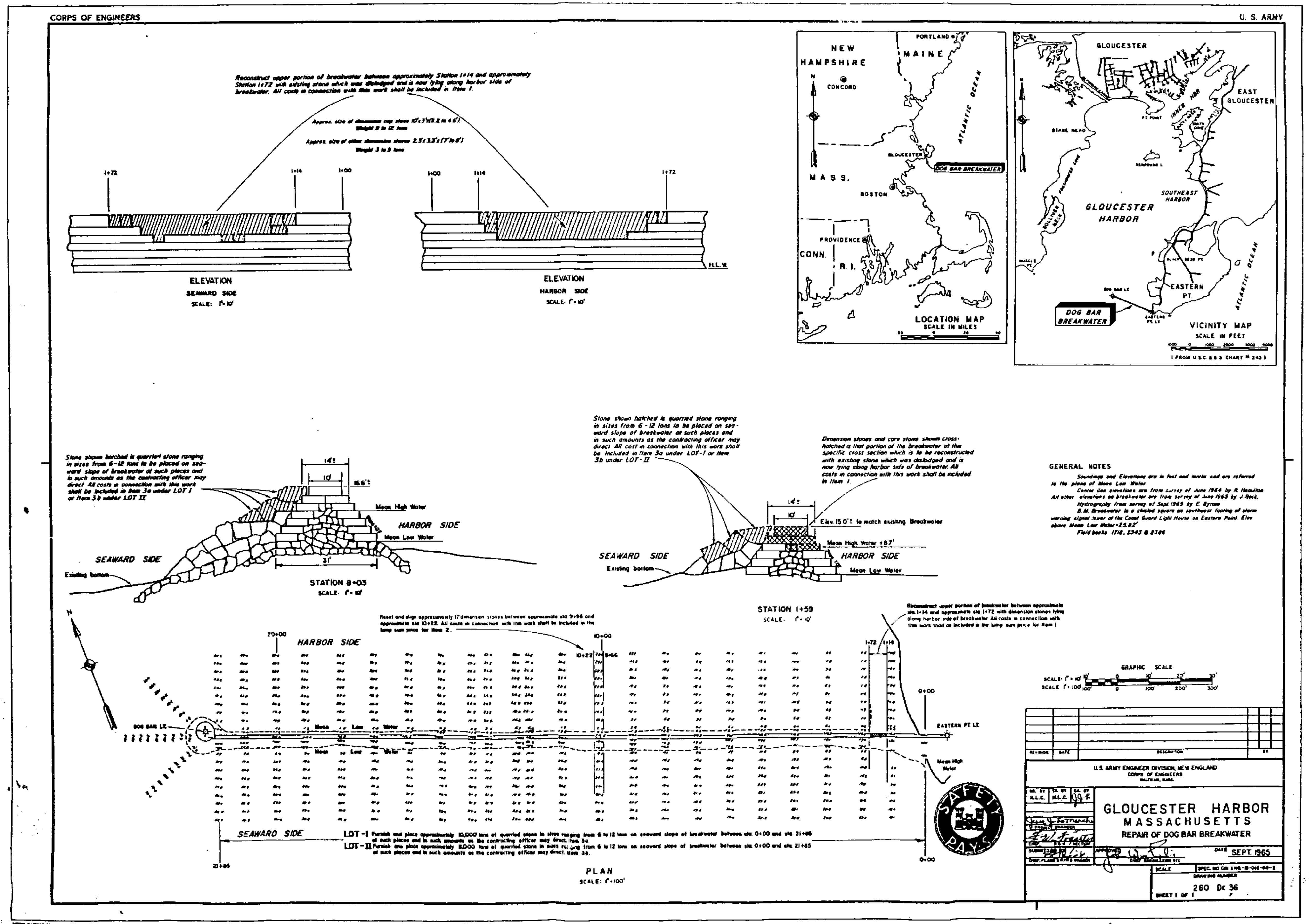
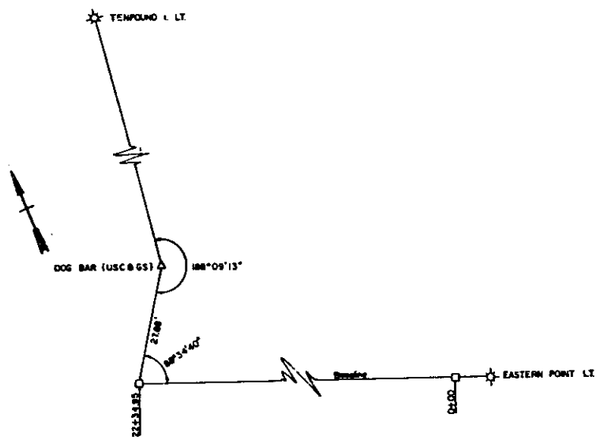
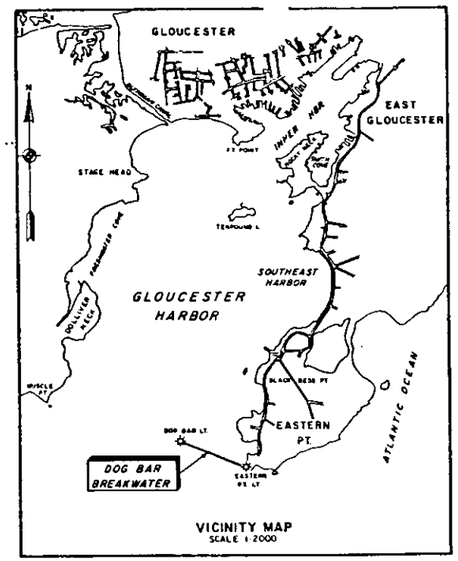

CORPS OF ENGINEERS
U. S. ARMY
Reconstruct upper portion of breakwater between approximately Station 1+14 and approximately Station 1+72 with existing stone which was dislodged and is now lying along harbor side of breakwater. All costs in connection with this work shall be included in Item 1.
Approx. size of dimension cap stone 10'x3'x(3.2 to 4.6')
Weight 8 to 12 tons
Approx. size of other dimension stones 2.5'x3.5'x(7' to 8')
Weight 3 to 9 tons
1+72
1+14
1+00
H.L.W.
ELEVATION
SEAWARD SIDE
SCALE: 1"=10'
ELEVATION
HARBOR SIDE
SCALE: 1"=10'
NEW HAMPSHIRE
MAINE
PORTLAND
CONCORD
ATLANTIC OCEAN
GLOUCESTER
DOG BAR BREAKWATER
MASS.
BOSTON
PROVIDENCE
CONN.
R.I.
LOCATION MAP
SCALE IN MILES
GLOUCESTER
EAST GLOUCESTER
INNER HBR
STAGE HEAD
TEN POUND I.
GLOUCESTER HARBOR
SOUTHEAST HARBOR
EASTERN PT.
DOG BAR BREAKWATER
VICINITY MAP
SCALE IN FEET
(FROM U.S.C.&G.S. CHART No 243)
Stone shown hatched is quarried stone ranging in sizes from 6-12 tons to be placed on seaward slope of breakwater at such places and in such amounts as the contracting officer may direct. All costs in connection with this work shall be included in Item 3a under LOT I or Item 3b under LOT II
14'±
10'
16.6'±
Mean High Water
Mean Low Water
HARBOR SIDE
SEAWARD SIDE
Existing bottom
31'
STATION 8+03
SCALE: 1"=10'
Stone shown hatched is quarried stone ranging in sizes from 6-12 tons to be placed on seaward slope of breakwater at such places and in such amounts as the contracting officer may direct. All cost in connection with this work shall be included in Item 3a under LOT-I or Item 3b under LOT-II
Dimension stones and core stone shown cross-hatched is that portion of the breakwater at this specific cross section which is to be reconstructed with existing stone which was dislodged and is now lying along harbor side of breakwater. All costs in connection with this work shall be included in Item 1
Elev. 15.0'± to match existing Breakwater
Mean High Water +8.7'
HARBOR SIDE
SEAWARD SIDE
Existing bottom
Mean Low Water
STATION 1+59
SCALE: 1"=10'
GENERAL NOTES
Soundings and Elevations are in feet and tenths and are referred to the plane of Mean Low Water
Center line elevations are from survey of June 1964 by R. Hamilton
All other elevations on breakwater are from survey of June 1965 by J. Rock.
Hydrography from survey of Sept 1965 by E. Byram
B.M. Breakwater is a chiseled square on southwest footing of storm warning signal tower of the Coast Guard Light House on Eastern Point. Elev. above Mean Low Water = 25.82'
Field books 1718, 2343 & 2346
Reset and align approximately 17 dimension stones between approximate sta 9+96 and approximate sta 10+22. All costs in connection with this work shall be included in the lump sum price for Item 2.
Reconstruct upper portion of breakwater between approximate sta. 1+14 and approximate sta. 1+72 with dimension stones lying along harbor side of breakwater. All costs in connection with this work shall be included in the lump sum price for Item 1
20+00
HARBOR SIDE
10+00
10+22
9+96
1+72
1+14
0+00
DOG BAR LT.
Mean Low Water
EASTERN PT. LT.
Mean High Water
GRAPHIC SCALE
SEAWARD SIDE
LOT-I Furnish and place approximately 10,000 tons of quarried stone in sizes ranging from 6 to 12 tons on seaward slope of breakwater between sta. 0+00 and sta. 21+86 at such places and in such amounts as the contracting officer may direct. Item 3a.
LOT-II Furnish and place approximately 8,000 tons of quarried stone in sizes ranging from 6 to 12 tons on seaward slope of breakwater between sta. 0+00 and sta. 21+85 at such places and in such amounts as the contracting officer may direct. Item 3b.
21+86
0+00
PLAN
SCALE: 1"=100'
SAFETY PAYS
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
GLOUCESTER HARBOR
MASSACHUSETTS
REPAIR OF DOG BAR BREAKWATER
SEPT. 1965
260 Dc 36
SHEET 1 OF 1

FIGURE E-11

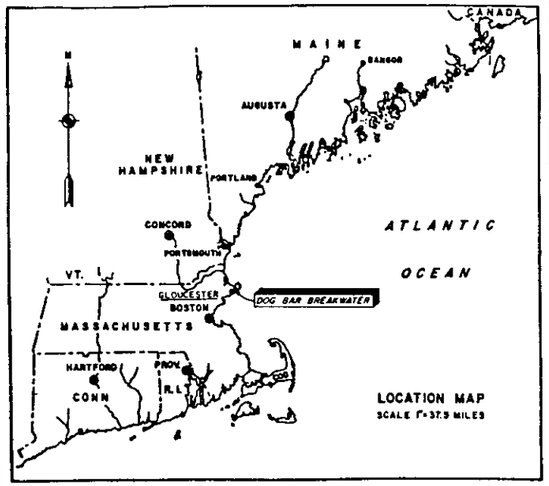
CORPS OF ENGINEERS — U. S ARMY



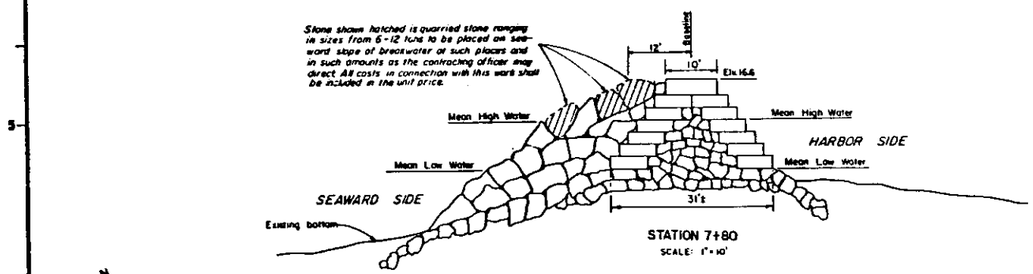
BASELINE CONTROL
NOT TO SCALE



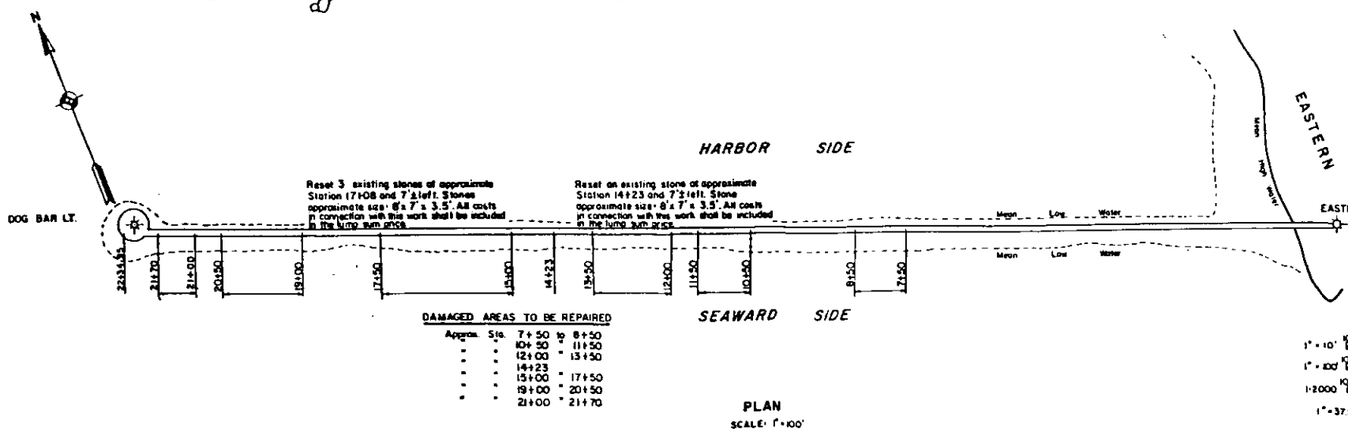
VICINITY MAP
SCALE 1:2000



LOCATION MAP
SCALE 1"=37.5 MILES



STATION 7+80
SCALE: 1"=10'



DAMAGED AREAS TO BE REPAIRED

Approx.	Sta.	7+50	to	8+50
"	"	10+50	"	11+50
"	"	12+00	"	13+50
"	"	14+23		
"	"	15+00	"	17+50
"	"	19+00	"	20+50
"	"	21+00	"	21+70

PLAN
SCALE: 1"=100'

GENERAL NOTES

Elevations are in feet and tenths and are referred to the plane of Mean Low Water.

Cross section survey by AQUATEC Inc., Burlington, Vermont, January 1979.

B.M. Breakwater is a chisled square on the southwest footing of storm warning signal tower at the Coast Guard Lighthouse on Eastern Point. Elev above Mean Low Water = 25.82'.

GRAPHIC SCALES
1" = 10'
1" = 100'
1:2000
1" = 37.5 Mi.

VALUE ENGINEERING PAYS DIVIDENDS

SAFETY PAYS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

GLOUCESTER HARBOR
MASSACHUSETTS
REPAIR OF DOG BAR BREAKWATER
PLAN AND SECTION

APPROVED: Chief, Engineering Division
DATE: MARCH 1981
SCALE AS SHOWN
SPEC. NO. DACW 33-81-B-0032
DRAWING NUMBER
308 Dr 37
SHEET 1 OF 3

FIGURE E-12